The Builder.

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ILLUSTRATIONS.

The "Equestrian" Tavern, Blackfriar's-road, S.E.—Mr. T. H. Smith, Architect ... *Double-Page Photo-Litho.*
Church of St. Nicholas-at-Wade, in Thanet: Elevation and Details of South Nave Arcade.—Drawn by Mr. H. P. Burke Downing ... *Single-Page Photo-Litho.*
The Entrance Porch, Sion College.—Mr. A. W. Blomfield, M.A., A.R.A., Architect ... *Single-Page Photo-Litho.*
Sculpture in the National Museum, Stockholm.—By Herr Fogelberg ... *Single-Page Ink-Photo.*
House at Bromley, Kent.—Mr. H. Percy Monckton, F.R.I.B.A., Architect ... *Single-Page Photo-Litho.*
South Transept, St. Alban's Cathedral ... *Single-Page Typo-Gravure.*
National Museum, Stockholm ... *Single-Page Typo-Gravure.*

Blocks in Text.

Sketch Elevation of new Façade to South Transept, St. Alban's ... *Page* 207
Exterior View of Hatfield House.—From a Sketch by Mr. J. Johnson ... 210
At Bolsover Castle.—From a Sketch by Mr. A. S. Buxton ... 211
Plan of the "Equestrian" Tavern, Blackfriar's-road, S.E. ... 214
Plan of a House at Bromley, Kent ... 214
Plan of Principal Floor of the National Museum, Stockholm ... 215

CONTENTS.

Restoration and "Ruination" ... 205
Testing Materials ... 207
Notes ... 208
Science and Manufacture ... 209
Hatfield House ... 210
Yorkshire Archæological Association at Fountain's Abbey ... 210
Bolsover Castle ... 211
Welbeck Abbey and its Tunnels ... 211
Appliances for Saving Life and Property from Fire ... 213
The Equestrian Tavern, Blackfriar's-road, S.E. ... 214
The Church of St. Nicholas-at-Wade, in Thanet ... 214
Entrance Porch, Sion College ... 215
House at Bromley, Kent ... 215
The National Museum, Stockholm ... 215
St. Alban's Abbey: South Transept ... 215
Memoranda from the British Association Meeting ... 215
London School-Board Committee ... 217
Old Cottage Architecture ... 218
Ancient Stone Cross found at Gloucester ... 218
Church-Building News ... 218
School-Building News ... 218
The Student's Column: Artificial Stones.—XII. ... 219
Recent Patents ... 219
Recent Sales of Property ... 220
New Roman Catholic College at Tooting ... 220
New Theatre, Coventry ... 220
Miscellanea ... 220

Restoration and "Ruination."

THE question of church restoration seems in a fair way to take the place formerly occupied by the sea-serpent and the gigantic gooseberry. It is becoming one of the favourite amusements of newspapers in the dull season. We commented the other day on the absurd excitement got up by some crack-brained enthusiasts in regard to the repair of Costessy church; and the solemn and orthodox comments of the *Times* on a subject to which it would never have devoted a word had Parliament been sitting. But, behold! it is the off-season, and the floodgates of archæological talk have been unloosed, and the misdeeds at Costessy have given rise to a whole cross-fire of indignant and virtuous letters; the encyclical of the Society of Antiquaries has been reprinted in the *Times;* and the Institute of Architects has almost simultaneously issued its paper of cautions and good advice in regard to "the conservation of ancient monuments and remains;" and the privileged swashbuckler of the *Times* caps the whole with a general abuse of everybody, coupled with the usual advertisement of himself and his own dealings with the ill-fated cathedral of St. Albans.

The documents issued respectively by the Society of Antiquaries and the Institute of Architects have this unquestionable and (in these days) rather rare merit, that they are obviously issued in perfect good faith and with an eye to the public good in matters of art and architecture, and not to the glorification or the advertising of any individual; and that they are expressed with entire moderation of spirit and language; in this respect contrasting remarkably with the sensational and claptrap appeals of persons of the stamp of Dr. Jessopp and his allies. Of these latter and their views it is not necessary to speak at length here; and it must be certainly useless to reason with persons who have apparently lost all control of themselves, and who speak of altering the windows or roof of a decayed church as if it were a crime comparable with burglary or murder. We will only refer to the remark made by one of them, a certain "J. H. M.," who writes to the *Times* in support of Dr. Jessopp's nonsense, suggesting the establishment of a body in each county to form a tribunal to whom every scheme for restoration should be submitted, and adding,—

> "Whatever authority may be constituted, however, one thing is certain, and that is that the persons composing it must not be such as would be subject to the dominating influence of professional architects. They must be able to hold their own against the gentlemen under whose guidance, hitherto, so much mischief has been done."

This is the manner in which it is now the fashion for people to speak who owe all their knowledge of Mediæval architecture to the study and elucidation of the subject by architects. It is no exaggeration to say that Sir Gilbert Scott, single-handed, did more to illustrate the history of our cathedrals and churches than all the members of the "Anti-Scrape" Society among them, while the Institute of Architects has just put forth a document in regard to the restoration of ancient buildings, the only fault of which lies in its over-conservative character and the too great emphasis which is laid on the historical in contradistinction to the architectural value of a building.

In this respect the circulars of the Institute of Architects and the Society of Antiquaries run upon pretty nearly the same lines. Both emphasise the importance of the historical character of an ancient building, and the desirability of doing nothing to interfere with or falsify that. In regard to the Society of Antiquaries this view is perfectly natural, and what the Society is almost pledged to by its very name and profession. Antiquaries deal professedly with past history, not with present requirements, and frame their requisitions accordingly. Architects might be expected to look more to the architectural design and the practical uses of the building; and we suspect that this would be more the case than it is, in the Institute encyclical, if this document really represented the general opinion of the majority in the Institute. We are given to understand, however, that it practically represents rather the judgment of two eminent church architects, though formally and officially adopted by the Institute.

Considering this, the document affords curious evidence of the manner in which what may be called orthodox architectural feeling and principle has shifted round the compass since the Mediæval revival commenced. In the former days of that revival anything like respect for relics of the past on the ground of purely historical interest would have been scouted as a weakness; the main question was, were they or were they not purely Mediæval in character and date? If not, they were sinful excrescences, to be swept away without mercy, because they interfered with the Mediæval *ensemble*. This was no doubt a species of bigotry, which has been succeeded by a reaction of bigotry in the opposite direction. Now, whatever exists is to be protected, because it exists; without reference either to its harmony with the main style of the building, or its practical usefulness as a modern addition.

This historical view of architectural monuments is one of entirely modern origin. It never seems to have existed before the present century, and it is only in very late years that it has assumed its present importance. It does not follow from this, however, that it is a mistake or an absurdity. On the contrary, it may be considered to have been a defect in the perceptions of past generations, that they never recognised the historical interest and value of architecture as a record of the character and tastes of times past. Now that people have at last recognised it, they seem disposed to clutch at it and to cling to every remnant of old work as a precious possession which, once gone, can never be restored. It certainly never can; but something worth as much might be put in its place, if only we did ourselves justice and believed that things done in the present day, if done with all our heart, might be worth something to posterity, and become history in their turn.

It is the want of any hope or confidence of this kind that strikes one so much in the aforesaid encyclical of the Institute. A respect for the historical value of architectural monuments is one thing, a blind worship of everything old is another thing. One can hardly call it less than this, when we read that "the external halves of mullions, sills, and jambs should, where possible, have such parts as are decayed restored by dowelling new stone on to the old internal halves." What a way to treat stonework, and what a piece of fetish-worship of old fragments! Again, when the ends alone of beams and rafters of old roofs are decayed through leakages from gutters, "the old roof should not for this reason be discarded, but new ends should be scarfed on." The preservation of an old roof, unless it were a most unique and fine example, would surely not justify such a piece of unconstructional patchwork as this. Upon what principle, again, are absolutely modern

additions to be removable, while additions made a hundred years ago are to be held sacred? The theory implied, both in the Institute and in the Society of Antiquaries' circular, is that the changes in style in the furniture and fittings of a church are part of its "history," valuable records of the changes of taste at various periods. But why, in that case, are not the recent or "modern" fittings and alterations equally part of the history? They are not history to us, but they will be to our grandchildren. But the Institute circular evidently contemplates the removal of these:—"Any clearance of wall-linings, pavements, flooring, galleries, high pews, modern wall partitions, or other encumbrances (*provided they be clearly modern**), necessary before detailed arrangements are made for the restoration, should only be carried out under the direction of the architect," &c. We have not the slightest objection in most cases to the removal of high pews, galleries, &c.; they are mostly ugly excrescences, and at variance with the style of the church; but on what principle does the Institute recommend or allow their removal, any more than any other portions of "history"? Or will the authors of the "General Advice" define to us at what precise date things cease to be "modern" and become "history"? They will find it rather difficult to do so logically.

Why, again, does the Institute speak of "restoration" at all, if the object is to preserve everything as it is in its present state? That is certainly not "restoration," if the word has any meaning at all. "Restoration" implies bringing a building back to its original state, and sweeping away excrescences. This is obviously what the Institute does not recommend except in cases of completely modern additions; and it is illogical in recommending it in that case, since they are part of "history" as much as any other additions.

The "historical view" in its entirety, therefore, seems to us a wholly untenable one, the undue emphasis at present laid upon it being a natural and perhaps necessary reaction against the views of the earlier restoration period, which were for reproducing everything Gothic and sweeping away everything post-Gothic. The case as against this principle is put by the Society of Antiquaries as follows:—

"The Society cannot too strongly insist on the great historical value of our ancient parish churches, every one of which contains in its fabric the epitome of the history of the parish, frequently extending over many centuries. What would appear to the Society to be the duty of the guardians of these national monuments is not to 'restore' them, but to preserve them,—not to pretend to put a church back into the state in which it may be supposed to have been at any given epoch, but to preserve, a far as practicable, the record of what has been it state during all the period of its history.

The Society does not overlook the necessity of adapting the buildings to the wants of the present day, but it contends that the greatest part of the mischief that has been done to our churches has not added to the convenience of the buildings, which is in no way aided by destroying the more recent portions of a church and rebuilding them in a style which imitates the older portions, nor by the destruction of furniture and monuments only because they are not of the date which is assumed to be that of the church. New work done to suit new wants, and not pretending to be other than it is, will carry on the history of the building in the same manner as did the old, and the Society has no wish to prevent that from being done. It only urges that the ancient record should not be wiped out to make room for the new, nor falsified by making the new a servile imitation of the old. Uniformity of style was very rarely a characteristic of our old churches, and a part of the building or a piece of furniture in it is to be judged, not by its conformity to this or that style, but by its fitness for its place and for the work it has to do."

This is moderately and fairly put, and without the hysterical ranting which accompanies all the protests of the Society for the Protection of Ancient Buildings. As to the great historical value of our parish churches, we quite agree with the Society of Antiquaries. But the Society entirely overlooks the question of architectural design, and practically overlooks that of convenience. They *say* that they "do not overlook the necessity," &c., but they immediately go on to assert that the greatest part of the "mischief" (anglicè "restoration") done to our churches "has not added to the convenience of the buildings." Has it not? Nor, perhaps, to their order, decorum, and decency for divine service? Are we to take the Society of Antiquaries to be seriously asserting that the parish church blocked up with galleries in a decayed and corrupt Renaissance style, put in with no regard to the lines of the architecture, and the floor covered with square boxes, like the divisions of a cattle-market, was in as good and fitting and presentable a state for the celebration of public worship, and represented as agreeable a spectacle architecturally, as the church cleared out and restored to order and architectural consistency by a competent hand? If they mean that, they are asserting an absurd paradox, and showing as much bigotry in one direction as the mediævalising restorer shows in another direction. The argument, again, that "uniformity of style was very rarely a characteristic of our old churches," is one that must not be pushed too far. There is, at all events, far more analogy of style and feeling between one period of Mediæval architecture and another, than there is between any period of Mediæval architecture and Renaissance work. However good the latter may be, it makes an architectural discord; and if it is not very good, it is better away, history notwithstanding. The fact that the Mediæval architects made additions to a church in the style of their own day, without regard to the style of the existing portions, does not prove that they exercised the highest architectural judgment in doing so. Their naïve indifference to any style but that of the moment, their manner of patching a piece of their fourteenth-century Gothic on to a Norman or Transitional building, without the least regard to consistency of style or detail, is a very curious and significant fact in architectural history, but it does not prove that consistency in architectural design and detail is of no importance. It only appears as if the Mediæval architects were indifferent about it. Possibly they were wrong. Perhaps their architecture would have had even higher intellectual interest if they had exhibited a distinct effort to assimilate the new work architecturally to the old, preserving a certain distinction of character. Or, possibly (which does not seem to have occurred to any of the disputants in the matter) the Mediæval architects never contemplated or intended leaving a cathedral in a patchwork state in regard to style. They added or rebuilt as much as they could afford to build in the style of their own day. Each generation of them, had it possessed the time and the means, would probably have pulled down a whole cathedral to rebuild it in their own taste, regardless of "history."

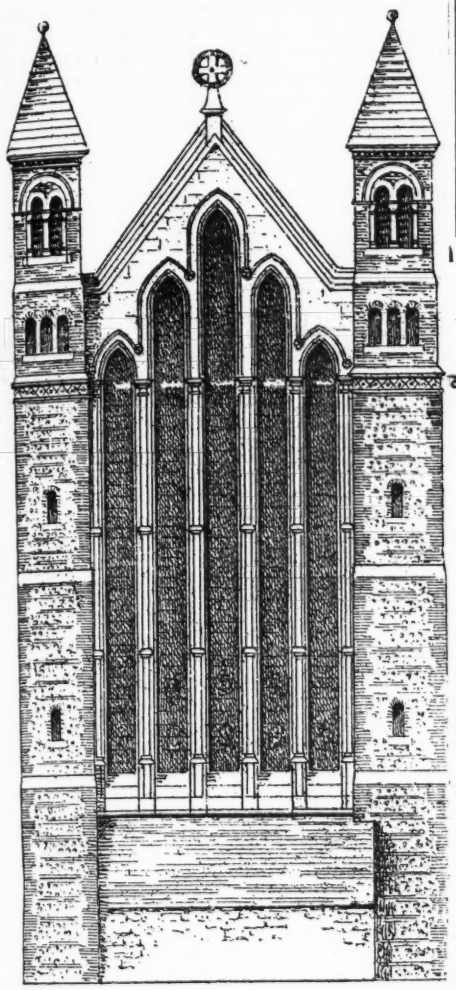
It is, however, the *rôle* of a society of antiquaries to emphasize the historical aspect of the question. But it is not the *rôle* of a society of architects to do so. The encyclical of the Institute is merely the antiquarian view over again. From this point of view, the advice given is no doubt good, and is from the experience of those who have had long acquaintance with ancient churches. If the object is to save every scrap of old work that can be saved, no advice could be better or more to the point than what is given in their code of suggestions. But some of it is advice such as never was given by "architects," in the true sense of the word, in any generation before this learned and critical one. The idea that an architect may be called upon to improve an old building never seems to enter the heads of the advisers. If the floors are out of level, this fault of level is to be carefully preserved.* Where it is absolutely necessary to construct a new roof, "either the old roof, where it exists, should be carefully reproduced, or the new roof should be made of the same pitch as the original roof," &c. Why "carefully reproduce" the old roof? Why not try to make a better one? That is what a Mediæval architect would have done. Then, "in all church restorations one main object should be to get rid of modern additions, put up without regard to architectural propriety." Precisely: and what are Jacobean additions to Gothic churches but "modern additions put up without regard to architectural propriety?" They are not "modern" now, but they were when they were done. Why are they to have the halo of sanctity merely because they have been there so many years? Consistency of architectural design and feeling is a matter of importance, and ought to be so regarded by architectural designers; the Renaissance and Georgian adapters of our churches absolutely ignored it, and the modern Institute of Architects, instead of cursing them, blesses them altogether.

It is the more to be regretted that the Institute should thus have emphasised the merely antiquarian view of architecture, and failed to take up the true architect's position in the matter, because they thus assist in giving a kind of point, which it would not otherwise have, to such a rampant assault upon everybody and everything architectural and archæological as Lord Grimthorpe's latest in the *Times*. Of all the absurdities of the recent letter-writing about restoration, perhaps the greatest is the appearance of Lord Grimthorpe as the champion of true restoration, considering the enormities of which he himself is guilty, and of which the *Times*, which can wax eloquent over such a little matter as Costessy church, seems to be, or chooses to be, entirely ignorant. On paper, however, there is a good deal in which Lord Grimthorpe is quite correct. His manner of writing, indeed, is so increasingly insolent and offensive that we wonder the *Times*, for its own credit as a journal, admits such letters; and it is natural that a cultured and courteous gentleman like the President of the Society of Antiquaries should feel that he is entitled to decline to take any notice of a critic who writes with such an entire and ostentatious disregard of all courtesy or good manners. But Lord Grimthorpe has a great deal of reason on his side, in spite of his ill manners, when he calls the policy of mere letting alone and patching-up of ancient buildings a policy of "ruination," and both the Institute and the Society of Antiquaries would have a better case if they recognised that architecture, as a living art, is something, and that archæology and history are not everything. We have always recognised that, and Lord Grimthorpe has been so much put out by the perverse reasonableness of our views on the matter, that he has found it necessary more than once to misrepresent us in the *Times* as being allied with the do-nothing and "anti-scrape" party; in respect of which he is in this predicament, that if he reads his *Builder* he knew that what he said of it was false, and if he does not he was in the equally dishonest position of making positive statements about a journal of which he knew nothing, to serve his own purposes. That, however, will not matter to Lord Grimthorpe; nor does it matter much to us. There is one portion of his recent letter, however, which it is worth while to comment on. Lord Grimthorpe is now flourishing Fergusson in the face of the *Times*' readers, as a supporter and admirer of his work at St. Albans. Concerning this it may be remarked that, although Fergusson was a remarkably diligent and comprehensive student of architectural history, and has left a unique book thereupon, which is of permanent value, he has never been recognised as an infallible, or even as a very trustworthy, critic; that his chief sympathy and his best comprehension were for Classic architecture—he never really understood or sympathised with Gothic; and that he was, as he himself told us, "as blind as a bat" (those were his own words), and could not recognise a man he knew at the distance of a yard; and, consequently, if he was carried off to look at and give his *imprimatur* to the front of St. Albans, it is impossible

* The italics are ours.

* Where, as in some exceptional cases, there has been a decided and intentional slope in the floor for the purpose of some fancy of architectural effect, of course this should be preserved, unless exceedingly inconvenient to the modern congregation; but the reference in the circular appears to be to varieties of level arising out of mere carelessness and bad building.

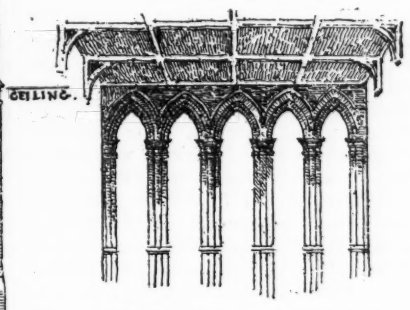
that he could have really seen the details, which are the head and front of the offending in this case. What is more to the point than all is, perhaps, that we have seen no evidence



Sketch elevation of new façade to south transept, St. Albans; showing the lancet lights carried above the ceiling-line, and the sham heads towards the interior.

of Fergusson's approbation except from Lord Grimthorpe's own statement in a letter in the *Times;* and as Lord Grimthorpe has more than once put in print imaginary quotations from our columns, invented by himself, we should not be surprised to find that his citation of Fergusson's words was equally imaginative and ideal, if the truth were known.

However, the more recent Grimthorpian architecture at St. Albans, at all events, was executed since Fergusson's death, and therefore cannot have been included in the blessings supposed to be uttered by that architectural prophet. And the transept work is ten times worse than the west front. The former we characterised as being essentially what might be called "Dissenting Gothic"; it is very bad, clumsy Gothic, but it would have passed muster fairly as a design for the façade of a great Dissenting chapel—taken as a whole, at least; some of the details are furiously bad, even from that point of view. The Clerk of Works who assisted in the west front, and who had picked up a kind of smattering of Gothic under Scott, is dead since then, and the new "ghost" seems to be inferior to the old one. What term to apply to the new south transept front we hardly know; "railway-station Gothic" would perhaps be the most appropriate. At all events, as Lord Grimthorpe applies the term "ruination," not unhappily, to the procedure of the party of ultra-conservatism in the treatment of ancient buildings, and as he poses as the champion of the architectural treatment of buildings, we have thought the best comment on his letter in the *Times* would be to publish an illustration of his last piece of work at St. Albans (see plate in this week's number), and ask any readers who know anything of architectural art, professional or amateur, what they think of that as a specimen of design to be stuck on to an ancient cathedral, and whether there is not more than one kind of restoration which may fairly be called "ruination"? The illustration is reproduced from a photograph, so there can be no pretence that it is not a fair representation. As far as its style and beauty of design are concerned, we leave it to speak for itself; comment would spoil it. But this is a remarkable design in other ways than style; there is more in it than appears on the surface. The reader will observe in the plate the bold and even sublime soaring up of the lancet windows into the gable. But what will he say when he is told that



Window as seen from interior.

these windows cross the line of the internal ceiling, and that sham window-heads are ordained within, as shown in the rough interior and exterior elevation subjoined, to range under the ceiling-line! If any student perpetrated such an absurdity in a design sent in for our Academy or Institute architectural prizes, he would be the butt and laughing-stock of his fellow students.* But this is the way in which a great English cathedral is allowed to be botched up by an architectural pretender who can pay for the privilege of amusing himself in this manner with a building which is the property of the nation; and it is the author of this kind of architecture who is allowed to lecture by the column on architecture to the English public in the pages of its leading journal.

TESTING MATERIALS.†

THE behaviour of building-materials such as stone, brick, timber, and iron when actually combined in a structure, and subject to the compressive and tensile strains which such a combination involves, must always be, to a certain extent, a matter of conjecture, as it is impossible to apply accurate tests to the materials in such a position. Up to a quite recent date it was assumed that the behaviour of such materials could be deduced from the phenomena observed with small specimens when tested in a laboratory under conditions as nearly as possible like those occurring in actual practice. For instance, if the average crushing strength, as ascertained by experiment upon a number of one-inch cubes of a certain kind of stone, were two tons to the square inch, the assumption was that we might take this as a constant, and deduce from it the crushing strength of a block of similar stone of nine square inches area. It was soon seen, however, that even with the small specimens there were considerable and inexplicable variations of strength, and it was rightly felt that the possible number of unknown disturbing elements would be largely increased as the size of the specimens became greater, and hence a very large margin of safety, in many cases as high as one-tenth the breaking weight, was prescribed. This "margin of safety" is, however, more or less a matter of guesswork, and it has been recognised of late years that the breaking strength of any material is not a sufficient criterion of its usefulness. The cases where any material actually used in a building is regularly and continuously loaded up to a certain point and the load then maintained at that point are so excessively rare as to be almost non-existent. In practice the loads are constantly changing, and the probability is that this variation of load has more effect than anything else upon the ultimate strength of the material. Thus Wöhler, in the exhaustive series of experiments which he made for the Government of Prussia, proved conclusively that an iron bar which would bear a steady load of 40 tons for an indefinite period without breaking would last but a very little while if alternately loaded with 40 tons and 10 tons. It has, therefore, been the aim of experimenters during the last few years to apply tests of varying character upon pieces of large dimensions, and these form the only trustworthy data upon which to base calculations. Germany and the United States have taken an honourable lead in these investigations, and we have already called attention to the experiments on timber made at the Massachusetts Institute of Technology by Professor Gaetano Laiza.* Professor Bauschinger, in Munich, and Dr. Böhme, in Berlin, have also carried on a series of the most elaborate and minute experiments with a view to ascertain the effect not only of purely statical loads but also of repetitions of strain and other variations. Unfortunately, the results of the tests made by these and other experimenters lie hidden in the scattered pages of numerous scientific journals, and Professor Unwin has conferred a great benefit upon English readers by publishing a considerable number of the results in his recent work on "The Testing of Materials." The difficulty of making these experiments lies in the fact that, with such materials as iron, stone, and cement, a testing-machine of very great power is required, and it must also register very accurately or it would be useless. It is needless to observe that such a machine is a very costly apparatus. One of the best testing-machines in this country is that at the City and Guilds Technical Institution at South Kensington, but it is nothing like as powerful as is required for an exhaustive series of tests, and is not to be compared with the machine at the Watertown Arsenal, near Boston, which was erected by Mr. A. H. Emery under an Act of Congress passed in 1875. This is described by Professor Unwin as probably the most perfect and reliable instrument in the world, as, although capable of exerting and registering a pressure of 450 tons, it is delicate enough to register the force required to snap a horse-hair. The results obtained from such a machine are so valuable that it would be well worth the while of any Government to follow the example set by that of the United States, and have one constructed. A series of experiments had been made under the order of the Government of the United States previous to 1875, by Colonel Gillmore, upon specimens of stone and brick with the best instrument that then existed, a 50-ton machine, but after the construction of the new and more powerful machine, it was resolved to extend these tests, and the results are published in the work now before us. The following materials were tested. (1) A kind of sandstone known as Haverstraw freestone in the shape of cubes varying from one to twelve inches on the side by regular increments of an inch; also the same material in the shape of prisms 4 in. by 4 in. area, and 1, 2, and 3 inches thick respectively, and 8 in. by 8 in. area and similar thicknesses. (2) Cubes and prisms of neat cement. (3) Cubes of mortar and of concrete mixed with cement in varying proportions. (4) Short brick piers built in cement. Great care was taken that the surfaces of the specimens in contact with the plates of the machines were as smooth as possible, and, to ensure this, a very thin coating of plaster of Paris was given them.

* The true way to treat the windows in such a case is that shown at York Minster, where the "Five Sisters" form the windows of the church itself, and the roof is lighted by a smaller series of lights, which fill up the gable-head. Lord Grimthorpe seems to have been improving on York Minster.

† Notes on the Compressive Resistance of Freestone, Brick Piers, Hydraulic Cements, Mortars and Concretes, by Q. A. Gillmore, Ph.D., of the United States Army. New York: John Wiley & Sons. London: Trübner.

* See the *Builder*, vol. 49, p. 632.

We believe this is the plan now generally adopted for securing evenness of bearing, and it is very interesting and instructive to notice in this connection the extraordinary results obtained when thin sheets of lead were placed between the surfaces of the material and the pressing-plates of the machine. In every case the specimens were crushed with a pressure far below that which was generally required to break them, and instead of showing the ordinary phenomena of breakage, viz., the two pyramidal fragments, they seemed completely to disintegrate and suddenly to go all to pieces. Professor Unwin's experiments entirely confirm these results. It appears that the lead not only penetrates into the minute interstices of the stone and thus acts as a wedge, but that at a certain pressure it begins to flow and then exerts a very powerful strain at right angles to that produced by the machine. This shows how wrong it must be to bed iron girders on lead sheets, or to place this metal between the stones of a column, as used to be the practice.

It would be impossible to allude in detail to the large number of tests recorded in the work in question, and we can only refer to the leading facts brought out. With reference to the stone cubes, it was invariably found that if the surfaces in contact with the plates of the machine were plastered, the blocks resisted a greater weight than when rubbed only, however finely this were done; thus giving an additional proof, if one were needed, of the great importance of accurately dressing the beds of stone used in buildings. The comparative resistance of various sized cubes, as shown in the experiments, is interesting, but we cannot think it safe to base any rigid conclusion upon the results, because the number of specimens tested was too small. For instance, the crushing strength of 1-in. cubes was greater per square inch of area than that of all other sizes operated upon, except the 5-in. and 6-in.; but we feel convinced that this must have been due to the fact of these latter specimens being more homogeneous than the others, and it would require far more tests to be made before any definite law as to the resistance per square inch of bed increasing or diminishing with an increase of the side, could be formulated. In any case the experiments point to one conclusion,—viz., that the results recorded in the "Transactions of the Royal Institute of British Architects," for 1863-4,* must by no means be implicitly relied on. In the tests of prisms of stone of the same area of bed but less height than the cubes, the results were invariable that the less the height as compared with the bed, the greater the strength of the specimen per square inch of bed. This almost appears to show that the particles of the material are acted upon by pressure much in the same way as columns, and that the smaller their height the less is their liability to be forced out sideways. But we still cannot avoid expressing our belief that the data are insufficient for laying down a precise formula such as the complicated one given by Colonel Gillmore on page 33.

The experiments on cubes and prisms of neat cement are not so interesting as those on blocks of cement, mortar, and concrete of varying proportions, as very few previous experiments on these materials have been made. Two kinds of cement were used, but neither is known in this country. The general results obtained may be summarised thus:—(1) That in comparing specimens of mortar made with varying proportions of sand, those which were strongest in cement bore the heaviest strain; (2) That in comparing mortars with concrete—the latter having in each case six volumes of broken stone added to the ingredients of the mortars—the concretes were the strongest. A few tests of brick piers, laid in cement gauged 1 cement to 2 sand, were made, and the average crushing strength was 119 tons per square foot. This is a far higher strength than is given in English text-books, and we have always believed that these have erred on the side of safety if good bricks and cement are used, but it would be manifestly wrong to rely upon a high compressive strength for many of the bricks which are now sold in the English market.

By far the most important results of the experiments which we are describing are those observed during the process of crushing, as these throw light on the resilience and the elasticity of the material, which, as we stated, are the most important qualities. We must refer the reader who is interested in the subject to the tables of experiments, but we may say that Colonel Gillmore may fairly claim to have proved that some law, similar to that which Wöhler discovered in the case of iron, does undoubtedly hold good with such materials as stone, brick, and concrete, viz., that the taking off a load and then putting it on again weakens the material more than if the load were continued, and that constant repetitions and relaxations of the load exert a very prejudicial effect on the material. For instance, a 16-in. concrete cube, which was ultimately broken with a load of 268,400 lb., was regularly loaded up to 50,000 lb., and the compression was measured at ·0048 in.; 45,000 lb. was then taken off and the set was measured at ·0028 in.; upon again raising the load to 50,000 lb. the compression was found to be ·0049 in., and the load was then regularly increased to 100,000 and the measured compression was ·0083 in.; the pressure was again reduced to 5,000 lb. and the set again measured at ·0042 in.; when the pressure of 100,000 lb. was again applied the compression was found to be ·0090, or an additional compression of ·0007 in. with the same weight. At 150,000 lb. similar measurements were taken, with the result that the compression after relaxation was ·0012 in. more than before. Similar results were obtained with the freestone, the neat cement, the mortar, and the brick piers. If these results should be confirmed by future experiments, it would seem that concrete suffers very slight diminution of elasticity when loaded up to nearly one-third of its ultimate crushing strength. The whole of the tables of observation and the diagrams of strain-curves are well worthy of careful study, not only for themselves, but because they are very suggestive of the lines which should be taken by future investigators. Our chief complaint of the work in question is that it is too pretentious. Colonel Gillmore has been unable to resist the temptation of attempting to lay down general rules from inadequate data, and before the conclusions which he suggests as probable can be accepted it will be necessary to carry out far more numerous experiments. We should be glad to see the tables and strain-curves, with the observations made during the experiments, published in a much less expensive form.

* See Tr. R.I.B.A., vol. xv., p. 166.

NOTES.

WE have received a circular from the Honorary Secretary of the Irish Exhibition (Lord Arthur Hill) embodying the following remarks:—

"Lately there has been a great increase in the articles, such as lace, embroidery, underclothing, painting, knitting, wood-carving, &c., sent over to the Old Irish Market Place by poor peasants in Ireland. In most cases this work is the senders' sole means of support, and it is most desirable that it should not be returned to them unsold. Visitors to the Irish Exhibition would be giving material help and encouragement to these poor peasants by going to the Old Irish Market Place, and making some purchases, however small."

While complying with what we presume to be the wishes of the Honorary Secretary by giving further circulation to this appeal, we cannot help pointing out that those who are thus endeavouring, with the best motives, to create an artificial market for the products of the industry of the Irish poor, are acting in a most illogical manner, and showing a very doubtful kind of philanthropy towards their Irish protegés. A request of this kind, thus worded, is in fact simply an appeal for charity veiled under a thin pretext of another kind; and if the effort succeeds in creating a kind of small artificial demand for these Irish products this year, it will only be at the cost of encouraging false hopes of a similar market next year. Considering that the Irish Exhibition has been largely got up and supported by people who profess to be philanthropists of the modern rational (or rationalistic) school, we have seen with astonishment the constant repetition of these appeals to the English public to discover a want for certain classes of goods, because they are made by Irish peasantry. We would give our hearty support to anything that would do good to the deserving poor in Ireland; but this will do no good.

THE struggle for life seems to be still in a doubtful stage at Windsor, where the insanitary state of many of the poorer houses has been the subject of comment in our columns from time to time for many years past. Certain houses in Distil House-row have been reported on as unhealthy four years ago by the Medical Officer of Health, in consequence of their having the waste-pipes in direct connexion with the drain, and only protected by a bell-trap. A fatal case of diphtheria is traced to this cause by the medical officer, and he has now reported the houses to the urban sanitary authority as unfit for habitation, in consequence of this defect and deficient w.c. accommodation. We have now to see for how much longer they will remain in their present state before any actual improvement is made. Windsor seems one of the slowest places at sanitary reform in the world.

THOSE who are interested in the very multifarious provisions of the Local Government Act just passed, will find their consideration of it assisted by a "Popular Summary* of the Law Relating to Local Government," drawn up by Mr. G. F. Chambers. This summary is in itself a considerable piece of reading, but it sets forth, in a readily intelligible form, statements of the practical effect and working of the Act in its bearing upon various departments of public work and procedure, with reference to the sections of the Act under which these provisions are respectively dealt with.

DR. DÖRPFELD publishes in the *Mittheilungen* of the German Institute at Athens (vol. xiii. part 2, 1888) a paper which will somewhat startle the archæological world. During the excavations at the Dipylon Gate, the mouth of a large cloaca a little to the south-west of the actual Dipylon was discovered. This cloaca debouches through the city walls just at the point which we have been taught to venerate as the site of the "Sacred Gate." Dr. Dörpfeld believes there was no sacred gate at all, but that the term was only a second name once used of the Dipylon, through which the Eleusinian procession went. This, however, he does not hold to be proved. Revolutionary as this view is, there are disclosures more surprising behind. Topographists have certainly been in difficulties what to do with the river Eridanus,—which of the small streams running into the Ilissus was to be identified with it. Leake made it out to be the small stream rising near the Kaeseriani Convent. Wachsmuth put it on the right bank of the Ilissus; Lolling holds it to be the Kykloboros. Dr. Dörpfeld, from an examination of the lie of the ground, and from the existing springs and watercourses of the modern city, comes to the conclusion that a river must have flowed right through the ancient city to the north of the Acropolis, rising in the south-west slopes of Lycabettus, passing through the so-called Sacred Gate north-west of the Pnyx hills, and finally joining the Ilissus where the modern road to the Peiræus runs, and that this river was the Eridanus. If this is so, the *loci-classici* on the Eridanus, in Strabo, Plato, and Pausanias are capable now, by the light of the new discovery, of simple straightforward interpretation. Surprise will naturally be felt that if the Eridanus flowed straight through the ancient

* London: Stevens & Sons; 1888.

city, mention of it is so rare. Dr. Dörpfeld points out that this is explained by the fact that the river was at an early time not only crossed by bridges, but almost entirely covered in, and he points to the pertinent illustrative fact that there are many inhabitants of Berlin who have never seen the river that flows through their own "Graben."

THE number is altogether a brilliant one. We can only briefly call attention to Dr. Winter's paper on his own interesting restoration of the famous Moschophotos, which we noted some time back. It is for him the text of a most important discussion on early Attic art, and the influence of the Chian school upon it. It will now no longer be possible to label a statue found at Athens as merely "Early Attic." The vast recent find of archaic statues is beginning to separate up into distinguishable classes, in which already pre-Chian and post-Chian are clearly discernible. It is fortunate that in the very same number, Dr. Six brings out his most ingenious restoration of the Mikkiades and Archermos basis, a restoration so delightfully neat and satisfactory that one almost trembles to accept it. Accepted, it settles for ever the question, long disputed, whether the winged Nikè belongs to the basis, and it gives us a certain standpoint and criterion for early Chian work that we have at that date for no other school. It is a piece of the greatest good fortune that the Acropolis excavations have yielded the actual signature of Archermos, so that this Chian influence is no matter of mere conjecture.

FOR some time past a correspondence has been going on in the columns of the *Times* respecting railway fares and facilities. Although the original question was the "one class only" proposition, other matters were soon imported into the discussion, and a very interesting letter appeared last Friday from Mr. John M. Cook, of "Tourist" fame, comparing the facilities afforded by our railways with those of other countries. It has frequently been argued (and proved) that in the matter of charges for goods-traffic the English manufacturer is at a disadvantage compared with his foreign competitors,—a state of things brought about by a number of different circumstances. But, as regards the convenience, safety, and speed of our passenger system, we can hold our own against any country. There are generally discontented people ready to disparage our system, because certain minor matters are managed better on the Continent or in America; but Mr. Cook emphasises the undoubted fact that in exchanging with any other country we should be courting "evils that we know not of." He sums up his wide experience as follows:—"I do not hesitate to say that there is no empire, kingdom, or country in which the general travelling public of every class and every grade have such facilities and such low fares afforded them as those afforded by the English railway companies in general." That such an authority as Mr. Cook should have arrived at such a conclusion,—after having, as he incidentally remarks, travelled more than 25,000 miles annually for upwards of twenty years,—must be highly gratifying both to the patriotic mind and to the railway companies themselves; although the latter will not be allowed to rest on their laurels while reform is still needed in the minor matters alluded to. Punctuality is a virtue in which some of our companies are sadly deficient, and the conditions under which return tickets are issued are often so unreasonable, that the question of "return tickets good till used" is worthy of consideration. It is extremely irritating to be called upon to forfeit a ticket without having received full value for the money paid for it, and the regulation prohibiting the transfer of a ticket is often a ridiculous absurdity. The statement that the fares in this country are as low as in any other will be received with some surprise, as we have been accustomed to think that for the superior accommodation which we enjoy we have to pay in proportion. The late Mr. Grierson, in the course of his defence of the English railways in "Railway Rates, English and Foreign," admits that the passenger fares in Belgium are lower than in this country, and writers in the *Times* during the present controversy have referred to the low rates in force in America. With the latter point, however, Mr. Cook ably deals in his letter; and, as he tells us that his interests are now greater on the Continent than in his own country, his conclusions must be received with the respect due to a, perhaps, unparalleled experience.

THE current number of the *Scottish Art Review* devotes a short article to enquiring why the new municipal buildings at Glasgow are not "what they might have been," a feeling which is said to be making its way "among the discriminating." We thought people, even in Glasgow, would begin to find that out before long. The critic has no objection to make to the general style selected, nor to the disposition of the ground-plan. The demerits he considers to lie in "an undue preponderance of horizontal lines, a faulty system of fenestration, producing a want of unbroken wall-spaces, a lack of artistic refinement in the details, and an over-lavish use of sculpture." In regard to the fenestration, the *Scottish Art Review* refers especially to the use of the so-called Venetian window, an arched compartment in the centre, and small square-headed compartments at the sides, separated from it by columns. The Scottish critic objects to this form of window that it destroys repose in a building, and is especially at variance with the leading horizontal lines of a classic design. We share his feeling about that form of window, which we have always thought one of the most artificial and unsatisfactory forms of window-opening. As to the other detailed criticisms, they may be true in general, but they do not touch the real defect of the building, which is in many respects a praiseworthy one, carried out with care and without sparing trouble, and so far creditable to its architect. But there is not a touch of genius about it. It is a respectable building, but absolutely uninteresting, and this we knew very well would be the final verdict on it at the time the design was selected. It will do very well for its purpose, but no one will be made happier by it, and no one will come to Glasgow to see it.

WHILE referring to the subject mentioned above, we may congratulate the *Scottish Art Review* on its continued high style of art criticism, and the generally cultivated tone of its literary matter. Glasgow is not, we fear, essentially an artistic town at present, but there appears to be a leaven of righteous men in it who will probably get up an artistic public spirit in time.

WE have received a card of invitation to what is called the "Continental Gallery" in New Bond-street, to see what is described as a collection of "the most remarkable paintings of this year from the Paris Salon." The announcement is little better than a fraud on public credulity. The collection does not contain a single one of the pictures which were prominent at the Salon Exhibition, and only one or two even by eminent names. The majority are of the most commonplace description, and many of them are mere artistic rubbish. To placard these as the most important and remarkable pictures of this year's Salon is an insult to French art. Of course the initiated know very well that it is not likely the best works from the Salon would come over here: they are commissioned or purchased in France; but the managers of a picture gallery have no right to gull the more ignorant public by announcements so completely at variance with fact.

Willey Park, Shropshire.—A large Cambridge chiming clock was completed last week in the parish church here, the gift of the Right Hon. and Rev. Lord Forester. The makers are Messrs. John Smith & Sons, of Derby.

SCIENCE AND MANUFACTURE.

AT the annual meetings of the British Association for the Advancement of Science we are informed what new discoveries have been made,—that is, a few of the most startling; and by the graciousness of the professors of science, and of those who apply it to the useful arts, a review of some of the discoveries and experiments which have been made during a term of years is placed before the meeting; all made as delightful as possible, not omitting a few jokes, or at least attempts which show the joyous spirit of the occasion.

But although science has its charms for a few,—those, namely, who can devote their lives to it,—it has not much charm for many who cannot do so. These, who have to earn their daily bread in one way or another, in some of the industrial arts of life, cannot know everything, for want of time, and in most cases for want of a previous education which would enable them to attain the knowledge. And it is not necessary, even if possible, that those who make things should each on his own account undertake an original research into the qualities and properties of the materials he uses and forms into articles of commerce; but it is yet very necessary that each should be informed of those qualities and properties which he cannot know by his own investigation. It is for the professors of science to see that the makers of things are each taught the nature of the material he uses, for, understanding its nature, he may produce without waste an article of value, because one of beauty as well as of use. It is for the professors of science to give this information to all who desire to have it. If, besides the makers of things, we regard the carriers of articles of commerce, whatever they may consist of or by whomsoever made (for it is said that we are now a nation of carriers, not shopkeepers), the case is still the same, for the means of carriage have to be provided, and this involves the making of appropriate implements and ways by which they may be transported, whether by land or sea; and the whole question is how to make things. As they must be made by the many, and as these cannot have a full knowledge of the nature of everything, they await the teaching of those who have that knowledge, by which they may learn the true nature of every material they use and apply, It may not be necessary to the immediate result that the workman shall himself understand these things; if the master understands them, and the workman is sufficiently intelligent to obey orders, that may be sufficient for the time. But, at least, the master must know the nature of the materials he uses, if trade is to be kept going. The workman, indeed, if he is wise, will not seek to know these things, for he cannot do so without the loss of that nerve and muscle which are his peculiar possession as workman,—nerve to give direction to the tool and muscle to compel its movement. The workman cannot attain a full knowledge of the nature of his materials without an amount of study which unfits him for his daily work, and a little knowledge of them is dangerous because it will probably seem to be sufficient when it is not really so; and the pursuit of the knowledge in full is to him too tiresome. So far as science is amusing it is worth the workman's attention, and that it is sometimes amusing we see by the attendance of so many people at the annual meetings of the British Association for its advancement; but, otherwise it does not make a man happy; it opens so many avenues of thought that the mind alone grows while the body starves. To shut the door of each avenue as soon as it has stood open long enough for personal happiness is the act of a wise man, if his circumstances are those of average men; but who can be at all times wise? Truly, we see a few of the professors of science, who appear rotund and sound enough in wind and limb, but they probably have had exceptional advantages and facilities for acquiring knowledge; but, whether with much or little difficulty, the knowledge of the nature of things is proper to be had by those who are able and willing to devote themselves to it, and to inform the world when they are assured of the truth of what they have discovered, by a sufficiently long examination of all the facts upon which their reasoning is to be based.

Persons in the average circumstances of life cannot do this, and knowledge which falls short of it is worse than none—knowledge, observe, not information, which is a very different thing. The man who knows,—the professor, say, of a science,—can impart information to persons

Hatfield House.—From a Sketch by Mr. J. Johnson.

whom he could never make to know what he knows, teach he ever so long; but the information he can give them (for their gratification, not knowledge) may be very useful to them in many ways, and they can put it to practical use every day. Of course, they have to trust what they hear to be true, to be full, to be honest, to be in every respect made in good faith; and this information, so imparted, is more useful to them than pseudo-investigations, which land them nowhere, more puzzled and uncertain than ever.

It remains that exact knowledge of all materials should be taught by competent professors to all who make things for sale abroad or use at home. We should be better off at home if workmen felt they understood the nature of the materials they use, and that to do the work well was a matter of interest to them; they would be quickened in spirit, and welfare would ensue. If this cannot be done—whether for politico-economical reasons or any other—at least the employers of workmen may be so instructed, and possibly the spirit of the master may inform the rest. When the very great number of materials is considered which are daily worked upon in England, it will be seen how far and how much science is required in their use; notwithstanding that the whole subject may cover but a small part of the ground of science altogether.

Sir Frederick Bramwell, the President of the Association for the ensuing year, is a civil engineer, using that term in its full sense as embracing all engineering other than military, and in his address to the meeting the other day at Bath he said that, although engineering does not contribute much to pure science by original research, but devotes itself more to the application of science in following its art of directing the great sources of power in nature to the use and convenience of man, yet, for the very object of the Association, the advancement of science, it is absolutely necessary there should be the application of science.

Abstract science, or original research, and its application, as in engineering, act and re-act upon each other, it was said,—an illustration of which was the story of Galileo, Torricelli, and the pump-maker; that Galileo first, and his pupil Torricelli afterwards, were led to investigate the question of atmospheric pressure by observing the failure of a pump to raise water by suction above a certain level, and these men of science, reflecting upon what they saw, discovered the conditions under which water rises in a pipe from which the atmospheric air has been removed.

This illustration serves as well as any other to show the truth of many things about which people dispute. The inventor's principle is, what you find, keep; it is yours if nobody owns it. What you discover apply to your own advantage to the exclusion of everybody else. This principle is good or it is bad, according to what it refers to, whether to the application of a universal law of nature already discovered, or to the discovery of the law itself. Galileo and Torricelli discovered the conditions under which a universal property exists, and proclaimed them; the knowledge is public property; but being so, an individual has no personal interest in pursuing such researches; they must be undertaken, if done at all, by those who work for ends other than private ones. It is the application only of these to special purposes which it is worth the while of the individual to follow out. He does, indeed, pursue them in a small way for commercial purposes, but stops when those ends have been attained. The one, in short, is science; the other, engineering or manufacturing.

A worthy tribute to the memory of one of the greatest of scientific men was made by the late President of the Association, Sir Henry E. Roscoe. When the Association last visited the city of Bath, in 1864, its President was Sir Charles Lyell, the great forerunner of that system of geology which has for its principle that the action of small things such as rain, as we now see it; frost, as we now feel it; and other occurrences such as take place at the present time, are sufficient, often enough repeated, to account for the vast changes which have evidently taken place in the ground beneath our feet since its formation.

Lyell, said the late President, was a typical example of the expositor of nature's most secret processes. His work was that of an investigator of science pure and undefiled, and as such his life and labours stand for ever as an example to all those who love science for her own sake; but then, as now, it was recognised that just as man does not live by bread alone, so it is not only by purely scientific discovery that the nations progress or that science advances: the application of the results of scientific research to the great problems of everyday life is a necessity.

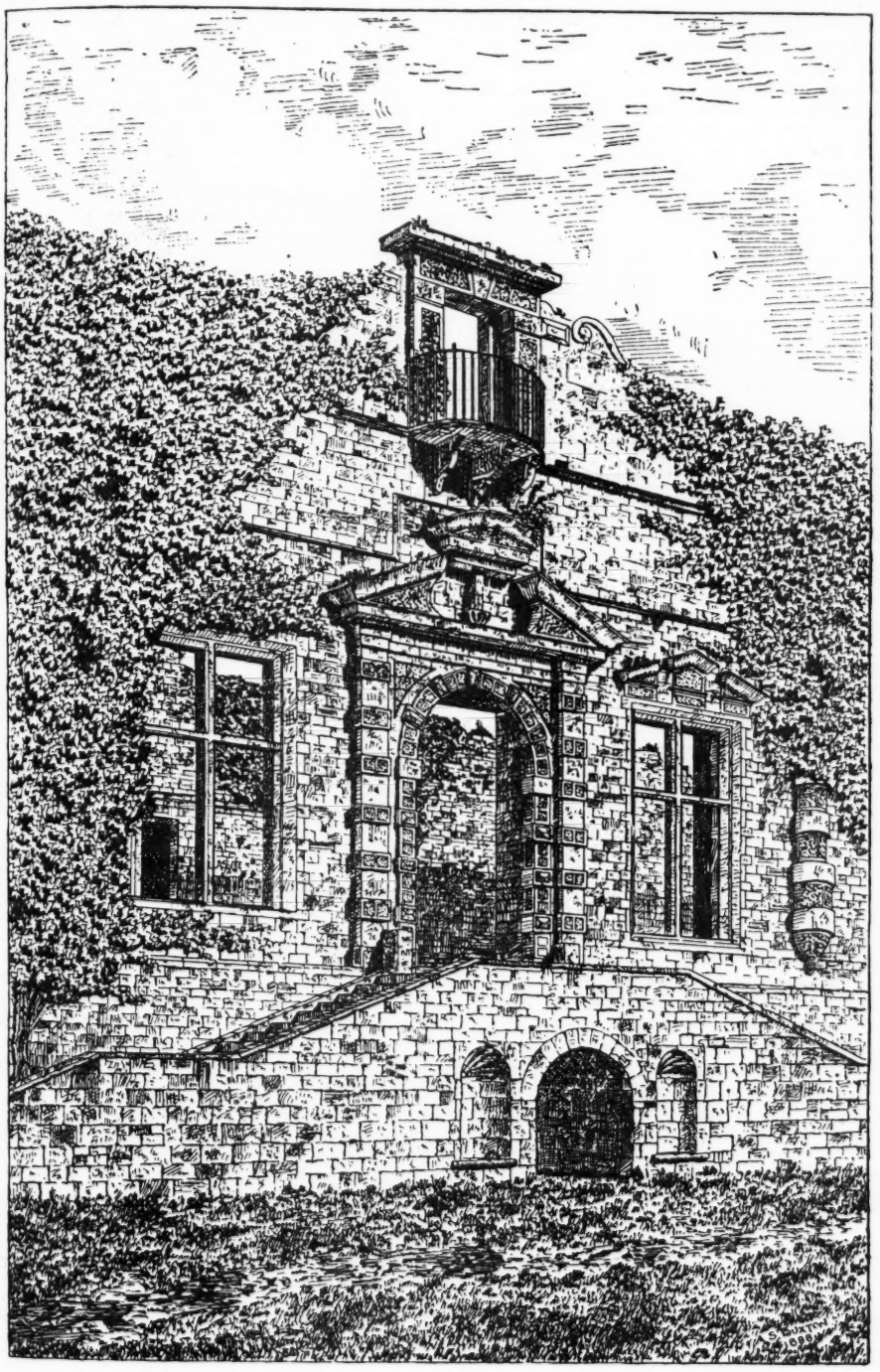
HATFIELD HOUSE.

THIS sketch of Hatfield House, for which we are indebted to Mr. J. Johnson, may be of interest in connexion with the account of the visit of the Architectural Association to Hatfield, and the paper on it by Mr. Gotch, reported in our last number (page 191–2, *ante*).

YORKSHIRE ARCHÆOLOGICAL ASSOCIATION AT FOUNTAIN'S ABBEY.

LAST week this Association paid a special visit to the abbey to hear an account from Mr. St. John Hope of the results of some recent excavations made by him on the site of the abbey. Mr. Micklethwaite previously read a paper on the "Cistercian Rule;" and after a short address from the Marquis of Ripon, who expressed his gratitude to the Society for the work they were doing in connexion with the elucidation of the history of the abbey, Mr. St. John Hope conducted the members over the abbey. He prefaced his remarks* by sketching the foundation and early history of the abbey, after which, in the course of his general observations, he said it was not easy to discover the original disposition of the church. The popular notion was that when, in Mediæval times, people built a church like that, they intended to have a grand view from end to end. That was an erroneous opinion. They built in that manner because it was the easiest way of building, and having got their erection, they proceeded to cut it up by screens. There was no documentary evidence to tell them how the house at Fountains was divided, but the original limits of the church were different to what they were now. He could not say whether the nave and the aisles showed their original setting out. The limits of the early choir were marked out by thin lines in the grass upon the platform near where he was standing. The Cistercians seemed to have generally completed the plan of a church before going on with the other portions of their structure. The choir originally, like most Cistercian choirs, was flanked on either side by three chapels projecting eastward from the transept. The old choir must have been very dark, because there was just room for a narrow window on either side. There was very good and clear proof of walls dividing the church from end to end, and in some of the Cistercian abbeys they were marked even more strongly than at Fountains. The evidence as to the *conversi* stalls he was not quite sure about, but three of the pillars on either side had the plinths chopped down, and his theory was that that had been done to fit the ranges of stalls. Another feature was that the aisles and the nave were cut by screens at intervals into a number of chapels. There was a chapel in almost every bay. The roofing of the aisles was peculiar. The ordinary way was to have a regular vaulting right along, but here an arch was thrown from the pillar to the wall, and then a pointed barrel vault from arch to arch. It was rather a weak form of building, and not at all English in feature. There were strong indications of an organ having been erected at the west end, because against the pier there were cuts for two very strong beams, and other marks. Against the west end of the choir there was a solid stone screen, with a sort of music gallery on the top. Between two screens there was a space in which sick brethren used to sit on a bench. There was a great rood screen, with images of Our Lady and St. John. In the last few days he had excavated the pits underneath the upper rank of stalls, and the total number of earthenware pots found embedded in the walls had now reached the number of twenty-four. One authority advanced the theory that they were put there to augment the sound of the music; but on the south side there were no traces of pots, and it might be that the singing

* We take the report as given in the *Leeds Mercury*.



At Bolsover Castle.—From a Sketch by Mr. A. S. Buxton.

was better on that side than on the north.* That the central tower collapsed at an early date was clear by the buttresses. The community must have first under-pinned the Norman work, and then, finding that to be of no use, had built the great buttress, which looked uglier now than when the stalls ran past it. The central tower had fallen certainly just before the suppression of the house. The great tower was one of the most imposing in the North of England. Near it was an altar to St. Michael the Archangel, with a bracket for the image of the Archangel. The Norman part of the choir was utterly gone, and even of the later work there were no remains whatever. What was commonly known as the altar platform, and was supposed to have been the high altar, was nothing of the kind. The high altar was a solid piece of masonry rising through the ground, and that was not it at all. Behind this platform, and underneath the perpendicular window, were the nine altars against the east wall. Each altar was divided by a solid stone wall, and subsequently the number was reduced from nine to one. The whole of these altars were screened off from one another and from the church, so as to leave a passage from end to end.

* We need hardly observe that this explanation of the frequent building of pots into the walls of the choir of a church is a very old one, and not so absurd as Mr. Hope seems to have implied. Has he any other explanation to suggest?—ED.

BOLSOVER CASTLE.

MR. A. S. BUXTON sends us the accompanying sketch of part of the ruined portion of Bolsover Castle, in illustration of the recent visit of the Architectural Association during their annual excursion, reported in the *Builder* of August 18 (page 118).

Remains of a Norwegian Cloister.—Herr Nicolaysen, Norwegian State antiquarian, has just completed the excavation of the ruins of an ancient monastery, on the west coast of Norway. The assembly-hall, sacristy, and refectory have been laid bare, as well as the covered corridor running along the courtyard. The roof of the assembly-hall appears to have been supported by a huge pillar in the centre. A large number of finely-cut sandstone blocks have also been found, making certain parts of the edifice almost complete. These blocks were obtained from a quarry close by, celebrated for the quality of its stone in olden times. All the details of the architecture show a rich and advanced Romanesque style, and the interior arrangements are generally identical with those found in early English monasteries. The whole building remains form a square, with the chapel on one side and the dwellings on the two others, the fourth being a brick wall. A few graves were encountered, but only one contained human remains. The skeleton is believed to be that of an abbot, from the cloak and mitre found with it.

WELBECK ABBEY AND ITS TUNNELS.

WELBECK ABBEY is situated in the midst of that district of Nottinghamshire still known as Sherwood Forest, though a large portion of it has long been disafforested. The Abbey forms also a part of the "Dukeries,"—a tract of well-wooded lands so called because within a circle of ten miles there were no less than four mansions once owned by Dukes, viz.: Thoresby, the Duke of Kingston's; Worksop Manor, the Duke of Norfolk's; Clumber, the Duke of Newcastle's; and, lastly, Welbeck Abbey, the seat of the Dukes of Portland since the middle of the last century. Worksop no longer stands in its entirety; Thoresby now belongs to Lord Manvers; but Clumber and Welbeck still have ducal owners.

As is well known, ever since the death of the fourth Duke of Portland, in 1854, very extensive works have been carried on underground at Welbeck, works about which a sort of mystery hangs, as well as about the fifth Duke, who designed them and carried them out. For some reason of his own, the Duke shunned the very sight of strangers, and he was in other ways also eccentric; but his chief eccentricity lay in the fact that he had come to the same conclusion as the aboriginal Britons, namely, that an apartment wholly or mostly underground has the double advantage of being warm in winter and cool in summer. To this, apparently, he had added a conviction that, if it could only be lighted, such a dwelling would be more comfortable than one wholly above ground and exposed to the alternations of frost and of heat which mark the English climate. Possibly he had read in Virgil's "Georgics" of our and his own forefathers' doings nineteen or twenty centuries ago,

> "Ipsi in defossis specubus secura sub altâ
> Otia agunt terrâ;"

and what they did rudely and crudely he resolved to execute in a more scientific manner. The Duke was fond of planning and designing; he was a first-rate amateur carpenter; and so he resolved, without destroying the noble building which he had inherited, to add to it another structure, or rather another series of structures, which should make it unique at all events among "the stately homes of England." Accordingly, he had not been very long in possession of Welbeck before he commenced the work of carrying out his designs, still only partly completed.

During the eighteen years that this Duke reigned at Welbeck, he is said to have carried out his building experiments at an outlay of £100,000 annually, and to have kept in active employ an army of 1,500 workmen, more or less skilled; indeed, writes the author of a local guide-book, "the villages of Holbeck and Whitwell owe a large proportion of their population to the apparently interminable works going on there." In fact, he showed himself a greater friend of "bricks and mortar"—or rather of hewn stone—than even Bess of Hardwicke. On account of the seclusion in which he lived, and the great reluctance which he felt to allow any part of Welbeck to be seen by strangers, he was known throughout Sherwood—and, indeed, through Nottinghamshire—as "the invisible prince;" and when it became known that he was excavating a new site in his Park, not far from the Abbey walls, for an entirely new subterranean structure, his neighbours indulged in all sorts of speculations as to whether the site was intended for a chapel, a library, or a ball-room.

It may be well, however, to state more in detail the improvements at Welbeck which are due to the late duke. First of all, the Abbey itself, we mean the part used for a private residence and facing the lake, was very low in comparison with its great extent of front; and therefore the Duke added a story to it, at the same time improving its internal decorations. Then, again, one of the great features of Welbeck Abbey, as it was known to visitors during the last century and the first half of this, was its great Riding House, erected by William Cavendish, the first duke, in the reign of Queen Anne and George I. This building the late owner converted into a gallery, in which to exhibit his fine collection of family pictures from Sir Peter Lely down to Sir Joshua Reynolds and the modern school. He increased its length to 180 ft.; he removed its ancient roof, substituting for it a new roof of corrugated copper, lined within with carved wood in the style of Westminster Hall; he panelled the walls after a new fashion, lining them with silvered glass, about a yard in depth, with cut-glass mouldings, and lighting the huge apartment with some

two thousand gas-lights, which, when lit up, give a most brilliant effect. He also inserted four huge chandeliers, each weighing something over a ton. "On the roof he added two turrets, in one of which is a clock of unique construction, made of hard gun-metal, and showing the time on four illuminated dials, striking the hours and the quarters; while in the other he placed a timepiece showing the time on two dials, driving two calendars showing the month, the day of the week, and the age of the moon, and equation of time on two dials." These were made by Messrs. Benson, of London. This building, as to the destination of which so many strange surmises were afloat, is now used as a picture-gallery, one end being screened off by a large thick curtain and used as a chapel. This picture-gallery covers a rood in area. Another huge structure of the same character, partly underground, is the library. It may be added that the present Duke has withdrawn many of the restrictions imposed by his predecessor on the admission of visitors, and thus has dispelled much of that air of mystery which surrounded the place.

But "in the lowest depths," they say, "there is a lower still," and so beneath this half-underground structure immense wine-cellars have been dug out and made, and lined with bins, all of cast-iron; and subterranean passages connect these cellars with the Abbey itself, the kitchen, and the servants' apartments, almost of palatial magnitude. The kitchen, it should be here remarked, stands at a respectful distance from the Abbey, and "its arrangements combine everything which art, wealth, and ingenuity could devise to render it complete." And our readers must not think that we are romancing when we add that the dinners are conveyed to the dining-room in the Abbey proper from these apartments by a short underground railway.

In other respects, also, the late Duke so far altered and improved the Welbeck which was built in semi-monastic style in 1604, that the only surviving architectural gem now to be discovered *in statu quo* is the Gothic Hall, which was restored by the Countess of Oxford, his maternal ancestress, in 1751.

But the most extraordinary of all the late Duke's building works, and that which has been most widely spoken of, is the subterranean roadway which he formed through a portion of his park, even carrying it by a tunnel under the great lake. This roadway he designed in order to supersede the road through the park to which the public had, from time immemorial, a "right of way," and which the stout yeomen of Sherwood Forest would not be inclined to allow even "the Duke" to stop up, any more than the inhabitants of Sevenoaks would allow the Lord of Knole to shut his gates against them. Still, the Duke resolved to find out a way to satisfy the law, and yet, at the same time, to gratify his taste for seclusion. He accordingly first sunk the roadway several feet underground, so that the eyes of passers-by were just on a level with the turf; and then, as in winter this sunk way would hold the rain, and not suffer it to escape, he arched it over partly with glass and partly with turf, externally removing the eyesore of long glazed roofing by plantations of rhododendrons and other flowering shrubs. This passage, which cuts off more than a mile between the Abbey and the neighbouring town of Worksop, is lined with glazed white bricks, and lighted from above by circular lights of plate glass; these are twelve yards apart, with intermediate gas-lights, which are kept burning day and night, for the convenience of passengers. This tunnel, though large enough to admit a carriage and four, is used only by the carriages of the family and their visitors, being shut against others, as there was no right of way above ground for other than foot-passengers. In this subterranean road the Duke has placed a drinking-fountain, which now takes the place of the Welbeck Ale, which was formerly at the command of every wayfarer who chose to call at the Abbey gates. One of the local guide-books ascribes this fountain to the late Duke's "usual thoughtfulness" for others; while another alludes to it sneeringly as an arrangement due to parsimony. The entrance to this subway is opposite the South Lodge of the Worksop Manor estate, from which Welbeck is generally approached by visitors, and the roadway itself terminates, not at the Abbey itself, but at the new buildings near Holbeck. It is about a mile and a half in length. About these new buildings, distant half a mile from the Abbey, we must now speak.

On emerging into the light of day from this tunnel, through some portion of which he must pass from whatever point he enters the park, the visitor finds himself face to face with a long series of new buildings of stone, divided into separate blocks. Before him is the building used as a school, and on the right and left are the abodes of the coachmen, stablemen, and grooms. The principal stable forms a quadrangle, at the gate of which the visitor will find someone to show him in what direction to turn; for, to say the truth, it is rather a perplexing task to find one's way about this huge encampment—for such it seems to be. In the far distance before us we see a long range of buildings, in a style apparently imitating the Abbey itself, and for which, indeed, they are often mistaken; but these are only the farm-buildings, including the timber-yards, &c. On his left is the new Riding-house, which is no less than 385 ft. in length, over 100 ft. in width, and over 50 ft. in height. It is built of the native stone of the district. The roof is in three divisions, not unlike the nave and side aisles of a cathedral; the central one is circular, and made of iron and glass; the two side roofs are made of pitch-pine, covered with copper.

The hunting stables are fitted up with accommodation for a hundred horses, and are all fitted in a most luxurious manner, so that the saying in the neighbourhood is, "Better be a horse at Welbeck than a weaver at Nottingham." The floors are bright and gay with encaustic tiles; and the brasswork of the doors and mangers is kept bright and polished; and woe be to the groom who neglects this work. Another large range of stables is devoted to the Duke's carriage-horses, and these and the coachhouses beyond are fitted up in the same expensive style. Other substantial buildings are grouped, at different distances, and apparently on no fixed plan, around the stabling, to which they are evidently regarded as subservient. On one side are the steward's offices, on another is a canteen, and on another the common room of the grooms, stablemen, and jockeys. Beyond these, again, is a spacious poultry-yard, with ornamental out-buildings, and a dairy of the newest and most costly fashion, lined with glazed tiles throughout, and kept cool by a *jet d'eau* in the centre, which plays day and night; and further still are an immense cow-house and a laundry, both designed and constructed on the newest and most approved plan. In another part of this remote portion of what we have termed the Welbeck encampment are the timber-yards. These yards are on a most extensive scale, and stand in the same relation to the Welbeck settlement as the kitchen does to the Abbey itself. The local guide-book writes: "They contain machinery of the very best construction for sawing timber with upright and circular saws, a saw-sharpening machine, with arrangements for steaming and steeping timber for preservative purposes. The shafting works are under the floors, and the machinery is driven by a steam-engine of thirty-five horse-power." The kennels are still further off,—a mile-and-a-half away.

In a line with the northern side of the new stables is an arcade, covered with glass, like that of one of our largest railway stations. This is nearly 1,300 ft. in length, and contains upwards of 64,000 ft. of glass. It was built as a tan-gallop for the exercise of the Duke's horses on rainy days, and in winter, when the ground of the park is frozen. The eastern and western terminations of this "tan-gallop" are of imposing magnitude. Far away, and scarcely visible from here, on the new Worksop and Mansfield road, are the gasworks, erected by the Duke to supply his stables, offices, domestic apartments, and the subterranean roadway.

If the buildings of Welbeck proper are so huge, the accessories of its gardens, hothouses, roseries, and so forth are quite in proportion to them. The range of hothouses and greenhouses close to the Abbey itself is several hundred yards in length, and filled with the choicest of English and foreign specimens. At a cursory glance one would say that they are scarcely surpassed at Sion House or at Windsor Castle. The kitchen garden alone (which is near the new stables) encloses within its walls no less than ten acres, to say nothing of six acres of orchard outside, and the main range of the hothouses here is nearly 800 ft. in length.

The gardens at Welbeck have been remarkable for their productiveness, even from monastic times, for the monks were excellent gardeners, and even in bleak and barren situations they often "made the desert smile." But here, in the midst of the green glades of Sherwood Forest, they had no such difficulties; all that they had to do was to fell and clear their pleasant well-watered domain. The garden has long been famous for its grapes, and especially for the Syrian variety, one specimen of which, weighing nearly twenty pounds, was carried on a pole by two men to Wentworth House, near Rotherham, twenty-five miles further north, as a present to Lord Fitzwilliam—much in the same way as the grapes from the land of Canaan were carried by the spies in the time of Joshua. In the pleasure-grounds between the Abbey and the new buildings grow many of the Mexican and Himalayan pines and firs, and other trees from North and South America, all in great luxuriance, to say nothing of araucarias and some Indian cedars, the seeds of which were sent home to Welbeck by the late Lord William Bentinck when he was Governor-General of India.

But it is not only on *terra firma* that the late Duke of Portland carried out his experiments and improvements. The lake before the Abbey, formed originally by damming up a brook, was designed by Repton in the reign of George III. It has now been extended nearly to Carburton, and is some three miles in length; it has also been widened in places, and deepened so as to prevent the growth of weeds, and its sides have been planted in such a way as to produce the effect of a natural lake. Added to this the deer park, ten miles in circumference, has been lately surrounded by an iron fence of excellent construction; but this, and the bull's-eyes in the turf of the park, elicit no feelings of gratitude from the fox-hunters of the county. So fond was the Duke of his plan of subterranean burrowings that even in the park lodges of his estate, five-and-thirty in all, he ordered the same construction to be repeated. Most of these lodges would make good, though small, vicarages for country parishes; and even though the stone was close at hand, they must have cost from 700*l.* to 800*l.* a piece. They form pleasing additions to an estate so large that in their absence it would look almost deserted of inhabitants; and a striking feature in their architecture is that the out-offices are all underground, being lit by large circular lights of plate-glass, which produce a curious effect when seen at night.

The Duke has lately had printed, on a small card, a brief summary of the measurements of the various parts of his estate. This card tells us that the underground tunnels measure nearly two miles and-a-half; viz., (1) the Main Tunnel: from the Abbey to the junction, 400 yards; from the stables to the junction, 1,170 yards; from the junction to the south lodge, 1,070 yards. (2) The Leper Tunnels: from the Abbey to the south lodge, 1,470 yards; from the dining-room to the riding-school, 1,020 yards. The picture-gallery measures, inside, 63 yards by 159 yards. The riding-school, externally, measures 132 by 36 yards; the tan gallop is 422 yards long; the hunting stables alone stand upon an acre of ground; the gardens, glass-houses, &c., occupy 32 acres; the lakes cover 159 acres; the deer-parks extend over 1,640 acres; and lastly, the iron-fencing round the deer-parks is just ten miles and-a-half in length. Such are "The Wonders of Welbeck" in 1888.

One special charm of the park at Welbeck is to be found in its oaks, many of which bear historic names; one of them, the Greendale Oak, has had an archway cut through its sturdy trunk, large enough for a carriage and four horses to drive through it. This and many of its compeers are supposed to be a thousand years old; so far back as 1790 they were described by Major Rooke in a book which he published, but which is now very scarce, entitled "Descriptions and Sketches of Remarkable Oaks in Welbeck Park."

Some idea of the huge settlement—for such it really is—that we have here outlined may be formed when we say that from the Abbey, on the margin of the lake, the furthest of the outlying structures is more than a mile distant, and that persons who drive over from Cresswell, and who come on the "new buildings" first, often drive away fancying that they have seen the Abbey itself, though they have not been within half-a-mile of the latter or seen its roof. On leaving the bounds of the Welbeck estate we find the road between the Cresswell Crags, where the late Duke of Portland has gratified the weary pilgrim's eye by damming up another little stream into a second lake or riverhead. These crags, on either side of the ravine, are deeply indented

with caves in the rock, partly natural and partly artificial.

We would strongly advise the pilgrim who may be so fortunate as to get from the Duke of Portland's agent an order to see Welbeck to approach it from Cresswell Station and these crags. He will thus see the least attractive portions of the estate first, and gradually work his way down to the Abbey itself, leaving the best and most interesting parts for the last. He will then do well to take a stroll in that portion of the park which is accessible to strangers, and to leave Welbeck by the underground tunnel for Worksop, whence he will rejoin the train. In former days, when railways were not, Welbeck was best approached from the little market town of Ollerton; but this place is now forgotten, and scarcely known, being five miles at least from any railway station.

The Abbey of Welbeck, founded in the reign of King Stephen for Premonstratensian Canons of the Cistercian order, was dissolved and suppressed by Henry VIII., when it was bought by an opulent clothier named Whalley, who sold it to Edward Osborne, a citizen and clothworker of London. From him it passed, through some intermediate hands, to the Cavendishes, Dukes of Newcastle, the first of whom we have mentioned as the original designer of the Riding-house here, and who is still known as the author of a folio treatise on "Horsemanship." His granddaughter and heiress, Margaret, carried the estate by marriage to Holles, Earl of Clare, in whom the Dukedom of Newcastle was revived; but it again expired for want of male heirs. His daughter and heiress married Harley, Earl of Oxford, the founder of the Harleian Library; and their daughter and heiress in like manner married William, second Duke of Portland, and so caused that family from that day to this to bear the name of Cavendish-Bentinck. The present owner is William John Arthur Charles, the sixth Duke of Portland, now Master of the Horse to her Majesty. The founder of the Bentinck family in England was General Bentinck, one of the favourite officers of William III., and his second in command at the Battle of the Boyne.

APPLIANCES FOR SAVING LIFE AND PROPERTY FROM FIRE.

A LITTLE while ago, when noticing the recent "Fire Rescue Exhibition" at the West End, we said that we would on a future occasion refer in detail to some of the most typical inventions there exhibited for the saving of life and the preservation of property from fire. We are now enabled to notice two of them,—one for saving life and the other for saving property.

The "'Cuff' Structural Fire Escape" is the invention of Captain A. St. George-Cuff, of Kilburn. This escape consists, essentially, in a balcony, or any number of balconies (according to the number of stories in the building to which the invention is applied) connected with each other and with the ground by ladders (with handrails). These ladders are only lowered when an alarm is given, so that they would not afford facilities for the ascent and descent of burglars. The invention of Captain St. George-Cuff possesses considerable practical merit, as will be seen by the detailed description we give of it, but it must be said that it is only houses of the Harley-street, Wimpole-street, or Baker-street type which would not be injured in appearance by iron balconies of the usual stock character at the level of each floor. But we apprehend that the balconies which are a necessary part of Captain Cuff's fire-escape might be treated architecturally, thus making an effective feature arise out from a constructive necessity.

We quote the following from the inventor's description of his appliance:—

"The invention takes the shape and appearance of an ordinary window balcony, and is attached to each floor of the building. In case of fire the pressure of a lever-handle, or pull of an ordinary bell-pull in the chamber or chambers to which the balconies are affixed, or pressure on a lever handle placed in a convenient position on the balcony itself, causes a ladder to descend from the bottom of the balcony, one end resting on the floor of the balcony beneath, the other end attached to the bottom of the floor of the balcony, from which it is lowered by means of an axle. As the ladder is falling into an inclined position at any required ang e, a trap-door formed of a portion of the balcony floor flies open, thus giving a means of exit by descending the ladder or steps. On reaching the balcony beneath, a similar lever-handle is depressed and a ladder or stairs similarly attached immediately drops. The same operation is repeated on each balcony till the ground is reached.

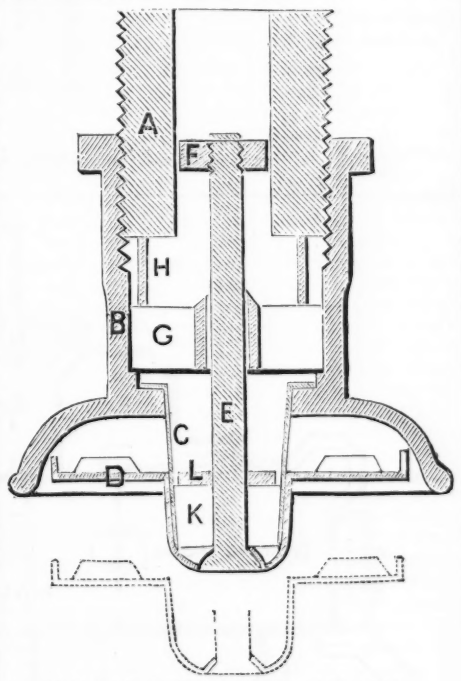
By means of a specially-constructed lock (patented) fixed close beside the hall door, a key for which is carried by the policeman on duty, the entire apparatus is actuated by the one motion of the key. It matters not how many floors there may be to the house, the instant the key is turned in the lock, and while the several ladders or sets of stairs are dropping into position, an alarm is given on each floor or in every sleeping-chamber by means of an electric attachment. The battery most suited is the 'American Continuous Alarm Action.'

There is hardly any possibility of any part of the apparatus failing to act by reason of oxidation, dust, or jamming. The only part that could be affected is the bearing of the ladder or stairs through which the axle passes, and the plummer-blocks in which the axle on which the cams are attached which hold the ladders up when not in use. To prevent rust or dust affecting any parts, all bearings are bushed with gun-metal, and both axles have moveable collars fitting tight with a thumb-screw to admit of their removal when it is deemed necessary to insert a small piece of Russian tallow; the collars can then be replaced and made secure by means of the thumb-screw.

Any person able to pull an ordinary bell-pull, or depress a lever-handle about 1½ in., can instantaneously drop the ladder or stairs. The lever-handle or pull when in the chamber is protected by a frame glazed and locked. In case of sudden emergency the glass is broken, the pieces falling to the floor, the lever-handle or pull can be used. When the lever-handle or pull is placed outside the house beside the balcony, a like protection is provided at the option of the resident.

Any person having the use of his or her hands and legs can have no difficulty in descending. The steps or rungs of the ladders are not round, as in ordinary ladders, but are formed of T-iron riveted at the proper angle; a flat step similar to a stair is provided. The outside of each ladder or stairs has a hand-rail of any desired height."

Working models of this invention which we have seen appear to fully demonstrate the practicability of Captain Cuff's invention, which, indeed, has been already applied to several buildings of importance, including the Imperial Opera House at Moscow. Since the invention was exhibited, we hear that Captain Cuff is fitting a set of his escapes to the London Hospital, Whitechapel-road, and that he has also been commissioned to apply them to the new extensions of Queen Anne's Mansions, Westminster.



Vulcan Sprinkler, Closed.—Actual size.

A.—Connecting Nipple.
B.—Body, nickel-plated.
C.—Copper Tube, nickel-plated.
D.—Deflector, nickel-plated.
E.—Stem, nickel-plated.
F.—Nut, screwed and soldered.
G.—Gallery.
H.—Distance Piece.
K—Paraffin Wax and $BaCO_3$
L.—Lead Washer.
(The dotted line shows position of distributor when open).

The other invention of which we have to speak is one for saving property from fire, and takes the shape of an automatic "sprinkler," known as the "Vulcan." It is the invention of Mr. James Henry Lynde, M.Inst.C.E., of Manchester (son of the late J. G. Lynde, who was for many years, if we mistake not, Borough Surveyor and Engineer of Manchester). We quote the inventor's description of the "sprinkler":—

"The 'Vulcan' is of the sealed type, and depends for its sensitiveness upon two principles, new in their application to sprinklers,—namely, the use of a non-conductor of heat interposed between the sprinkler and the water-pipe, and the prevention of contact between the water and the seal. The advantages of these principles were discovered during a long series of experiments, which were not made for the purpose of inventing a sprinkler, but for ascertaining why certain forms were more sensitive than others. The application of these principles resulted in the construction of two forms of sprinkler, one being suitable for ordinary purposes, and the other specially for the interiors of elevators and other similar situations.

The 'Vulcan,' for ordinary purposes (see section), consists of a brass body, B, connected to the water-pipe by means of wooden nipple, A. This prevents the heat absorbed by the body being conducted into the water and pipe, thereby retaining it where it is required. The brass body, B, terminates at its lower end in a short copper tube, C, projecting downwards. Over the orifice of this tube a cap, D, is secured by sensitive solder. The cap forms the central part of the distributor, D, which is provided with diagonal sails projecting upwards. Into the centre of the cup is fixed a stem, E, which passes upwards into the body of the sprinkler, through the gallery, G, and terminating with a brass nut, F, which is both screwed and soldered to it. In the interior of the tube, C, terminating the lower part of the body, is placed a plug of paraffin wax and carbonate of barium, K, which is covered with a lead washer, L. This mixture has the double effect of preventing contact between water and the seal of sensitive solder, and also of lubricating the parts when the sprinkler opens. The specific gravity of this mixture is 1·63, or about 1⅔ times heavier than water; its tendency, therefore, in the melted state, is to remain in its proper position. Both the substances used in this mixture are chemically inert, and no chemical action or combination takes place. It is a curious fact that when once this mixture has been made it is impossible again to separate the substances, unless by solution in ether, or by heat sufficient to evaporate the paraffin wax. Enquiry shows this peculiar property to be new to science. If paraffin wax is mixed with precipitated chalk (which is similar in its nature to carbonate of barium) and placed in water and warmed, the paraffin wax at once leaves the precipitated chalk and floats on the water, the separation being complete. In one case the mixture is friendly and in the other unfriendly. The melting-point of the mixture is 135 deg. Fahrenheit, or about 25 deg. Fahrenheit lower than that of the sensitive solder.

The action of the 'Vulcan' Sprinkler is as follows: When the temperature of the air in which it is situate reaches 135 deg. Fahrenheit, the mixture of paraffin wax and carbonate of barium melts, and assumes the consistency of thick porridge. Being heavier than water, it remains interposed between the sensitive solder and the water. When the sensitive solder has melted, the cup, with its deflector, D, and stem E, drops downward until a proper aperture has been formed for the escape of the water. It then rests upon the gallery, G, by means of the nut, F, at its upper end. The water impinges upon the distributor, and, by means of the diagonal sails, causes it to spin rapidly and distribute the water evenly over the space it is properly intended to protect. If the deflector be forcibly prevented from revolving it acts as a fixed deflector, and gives a satisfactory distribution. The outer surface of all exposed metal is nickel-plated, in order to prevent corrosion by the products of gas combustion. The 'Vulcan' is fitted up in a similar manner to that adopted in the case of other sprinklers."

It remains to be said that by a very ingenious mechanical arrangement, the flow of water ensuing on the coming into play of one of these sprinklers can be made to ring a large bell or blow a steam-whistle, or both. The object of giving an alarm of this kind is to apprise the custodians of the building, as an additional precaution, especially with a view to prevent undue damage by the flow of water after the fire has been extinguished.

Historical and Archæological Association of Ireland.—This Association will hold its next quarterly general meeting in the Court-house, Cashel, on Wednesday, October 3, 1888, at the hour of three o'clock p.m., when Fellows and members will be elected, the hon. local secretaries' reports and correspondence will be considered, and other business transacted. After the meeting the Rock of Cashel (for centuries the residence of the Kings of Munster) will be visited, and, if time permits, the Hoar Abbey and St. Dominick's Priory will also be visited. In the evening there will be a meeting at eight o'clock, when a number of papers on archæological subjects will be read.

Church, Birkdale Common, Southport. In a limited competition for a new church at Birkdale, the designs of Mr. J. Francis Doyle, of Liverpool, were selected by Mr. Ewan Christian, acting as assessor, and accepted by the building committee. The church will accommodate 600 worshippers.

Illustrations.

THE EQUESTRIAN TAVERN, BLACKFRIAR'S-ROAD, S.E.

THESE premises are being built for Mr. W. Turner on the site of the old "Equestrian" Tavern, adjoining the Surrey Theatre, Blackfriar's-road, and comprise extensive cellars in basement, bars and club-room on ground-floor, billiard-room, club-room, and residence on first and second floors, the third floor being arranged as a residential flat, which has been let, with offices on first floor, to the Hatters' Society, who for some years have had their headquarters at this house.

The front is carried out in red brick with stone dressings and granite pilasters on ground-floor, the ornamental frieze between the second and third floor windows being modelled in cement on a red back-ground; this, together with the other carving, having been executed by Mr. Gilbert Seale.

The whole of the partitions and fittings in the bar are in mahogany.

The works are being carried out by Messrs. Allen & Sons, of Kilburn, from the designs and under the superintendence of Mr. T. H. Smith, architect.

THE CHURCH OF ST. NICHOLAS-AT-WADE, IN THANET.

ST. NICHOLAS-AT-WADE is situate in the north-east quarter of the Isle of Thanet, and, according to Hasted, derived its name from its position, — the Wading-place over the river Wantsum, near the bridge at Sarre.

The church is characteristic of and presents all the distinctive features peculiar to the churches in and near Thanet. Much Norman and Early English work is to be met with in them, the latter period generally in the chapels and chancel aisles, though the windows and other features are often later insertions.

Splendid examples of early work, having more or less the same character, are to be found in St. Clement, Sandwich, and at Minster, both typical churches. These remains are of very considerable interest, and their details well worthy the most careful study.

The Church of St. Nicholas originally was a Norman structure, but a portion of the south arcade, and a pier, with the original base and cushion-cap on the north side, are the only remains of this period.

It would seem that the aisles occupy the position of the Norman plan, a part of the original south aisle being thus retained. As at St. Mary, Sandwich, and at Worth, it is probable there was a Norman tower at the west end of this church.

The walls of the chancel, the chancel arch, and the north and south chapels, are Early English, but all the original windows have been removed, and those of a later period inserted. Under the east window of the north chapel is a splayed recess, indicating the position of the altar. A part of the north pier of the arch opening into the aisle, it may be noted, is built of tufa.

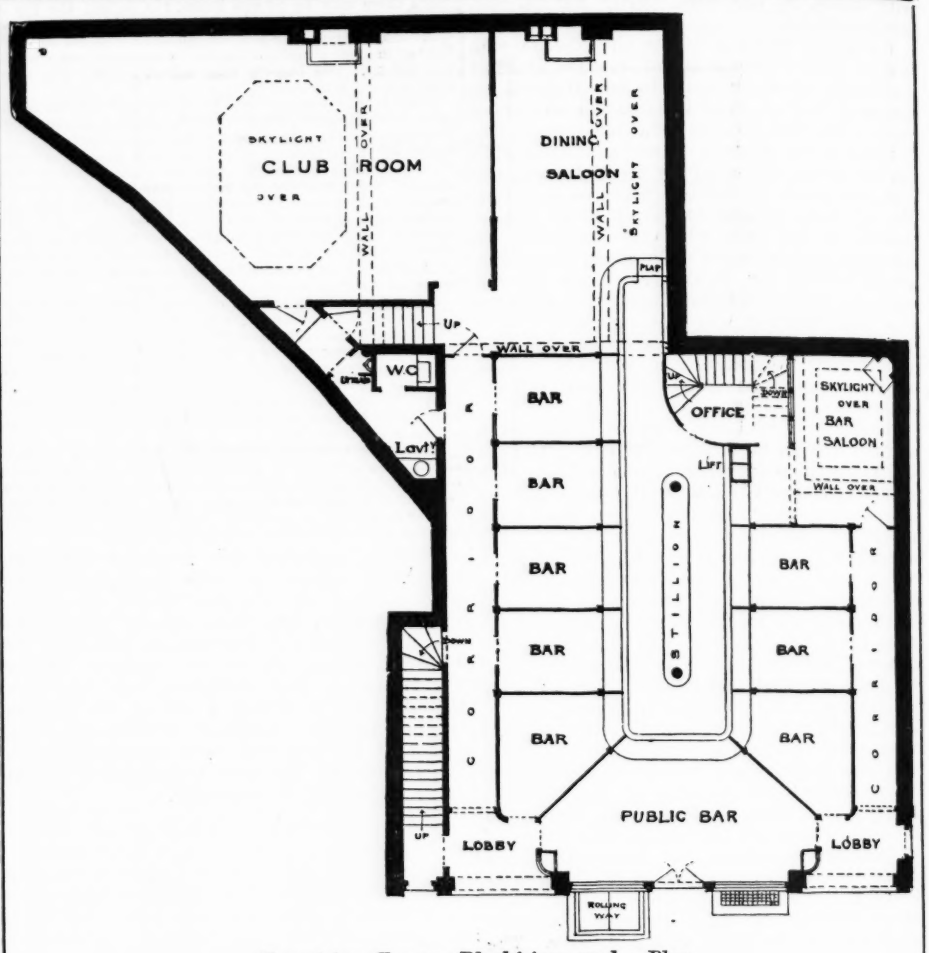
On the outside of the east wall of the South Chapel are indications of an early triplet window, and it is supposed that this was removed when a new window was built in, by the will of one John Andrews, of Thanet, in 1480, who devised six marks for this purpose, and ordered himself to be buried in the Chapel of St. Thomas the Martyr, on the south side. A parclose screen no doubt formerly occupied the arch into the chancel from this chapel.

It is supposed that over the rood loft, besides the image of Our Lord on the cross, were the images of St. Katherine, the Blessed Virgin Mary, and the Holy Trinity, altars and candles belonging to each. A part of the original nave roof still remains, and from it hangs a very fine candelabra, dated 1757.

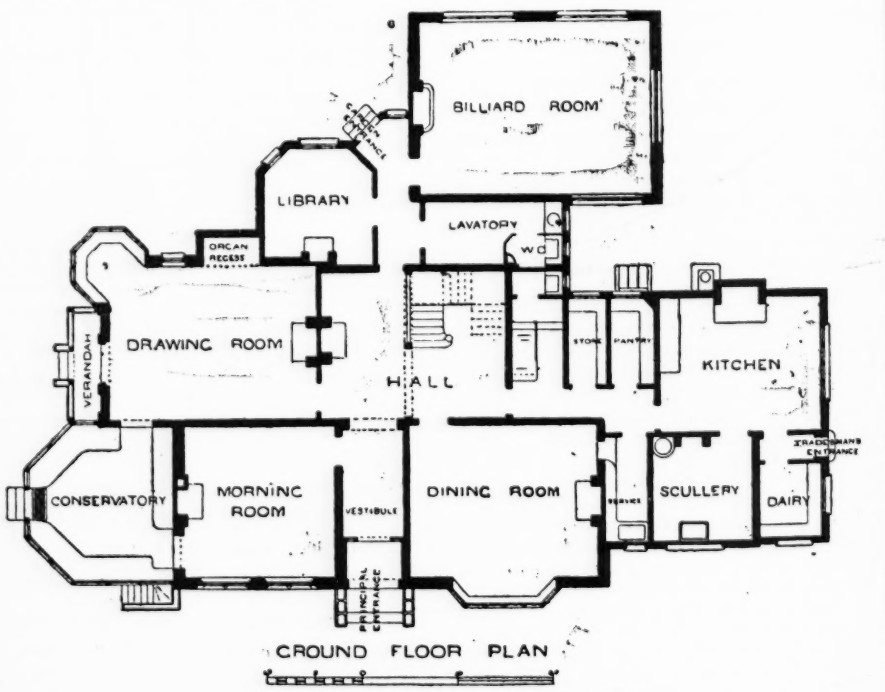
Decorated work may be seen in the south wall of the aisle, and the unusual way the wall breaks back, in order to meet the inner face of the tower wall (also of this period), should be remarked.

The fourth arch in the south and the whole of the north arcade, with the upper stages of the tower and the porch, are Perpendicular work.

Over the south porch is a parvise in very good condition, and retaining its original approach and fireplace. The tower, which was originally groined, is used as a baptistry.



Equestrian Tavern, Blackfriars-road.—Plan.



House at Bromley, Kent. (*See page* 215.)

St. Nicholas' Church was anciently a chapel of the Church of Reculver, and in the possession of the see of Canterbury, until it was united to the neighbouring church of All Saints, Sarre, and made parochial by Archbishop Winchelsea in A.D. 1298. Its fine tower, situate at the south-west angle of the church, is one of the noblest in Kent, and, built upon rising ground, forms a conspicuous landmark far over the Isle of Thanet.

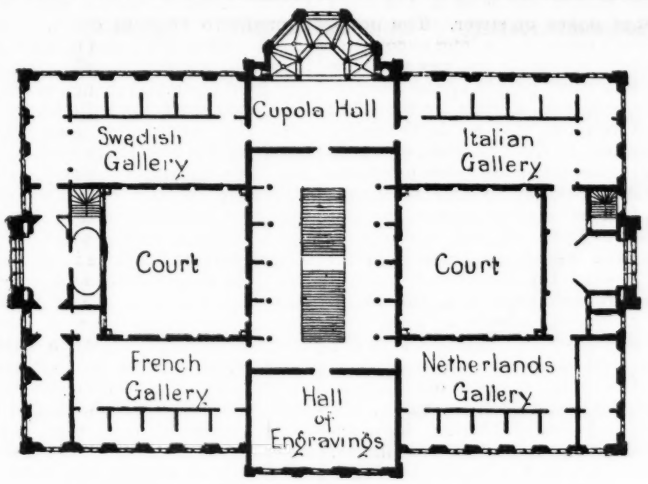
There is a good brass in the floor of the north chapel (now called the Bridges' Chapel), and an inscription in old English characters below the figures states the memorial to be Valontyne Edvarod, who died in 1559, and his two wives, Agnes and Joan.

"Here lyeth buried ye bodies of Valontyne Edvarod gentylman who had too wyfes Agnes and Joan by Agnes he had iiii sonnes and too daughters and also by Joan his second wyfe iii sonnes and vi daughters which Valontyne decessed the xxv daye of February in the yere of or Lorde God mcccclix after whose decese the ladye Joane maryede with Thomas Parramore and by him had a sonne and a daughter and the ladye decessed the fifthe day of Aprill in the yere of or Lorde God mcccclxxiiii whose soules God hathe taken to his mercey."

The male figure is probably that of Valontyne Edvarod, and the second of Thomas Parramore.

Undoubtedly the south arcade of nave is the most interesting part of the church, and, turning to the lithographed illustration, it will be seen that it consists of four bays. Its two eastern-most arches are equal in width and carried on Roman piers, while a striking feature is the very curious blending of Norman and Early English carving on the caps.

The first archmold is extremely beautiful, and seems almost unique. The third arch is Early English, and its simple and telling character



National Museum, Stockholm.—Plan of principal floor.

entirely accords with much of the work in the churches of Thanet.

The fourth arch, next the tower, is Perpendicular. It was most probably reconstructed when the upper stages of the tower were built, and is not nearly so true in style.

H. P. BURKE DOWNING.

ENTRANCE PORCH, SION COLLEGE.

WE give an illustration of another portion of this building, reproduced from a portion of the architect's working drawings. We gave an illustration of the details of the principal front in the *Builder* for May 5 of this year, and a description of the building in the *Builder* of March 6, 1886.

The architect is Mr. A. W. Blomfield, A.R.A.

HOUSE AT BROMLEY, KENT.

THIS residence, which is now in course of erection for Mr. A. Gurney Smith, of Bromley is situated on an elevated and well-timbered site in the Tootswood-road, and commands fine views of the surrounding country.

The materials used for the construction of same are dark red bricks and Bath stone dressings, the hanging tiles being bright red, and the roofs covered with dark purple Aylesford tiles, with bright red ridge tiles and lead-dressed finials.

The walls of second-floor are of brickwork faced externally with stout-framed timbers, and rendered between same with cement, and finished with rough-cast shingle.

All the constructional timbers showing externally, including barge boards, will be painted dull black, and the windows and sashes cream white.

The works, which also include extensive stabling and an entrance lodge, are being carried out by Mr. Ernest Roome, builder, of Clapton, under the superintendence of the architect, Mr. H. Percy Monckton.

THE NATIONAL MUSEUM, STOCKHOLM.

THIS is not a new building, having been in existence for some time; but, as one of the largest and most important public buildings in Sweden, on which no expense and pains were spared, an illustration of it may be of interest to English readers. The building was erected from the designs of Stüler, at a cost of considerably over £100,000. A plan of the principal floor is subjoined.

In another plate we give an illustration of the statues of Odin and Thor, by Fogelberg, which are among the prominent sculptural decorations of the interior.

ST. ALBANS ABBEY: SOUTH TRANSEPT.

THIS illustration, reproduced from a photograph, represents the new façade of the south transept at St. Albans, supposed to be designed by Lord Grimthorpe, or for which, at all events, he is directly or indirectly responsible. For further remarks on it, and our reasons for illustrating it, the reader is referred to the first article in the present number.

MEMORANDA FROM THE BRITISH ASSOCIATION MEETING.

WE put on record here some of the information or suggestions brought forward in papers read at the British Association meeting in regard to the class of subjects which are of special interest to our readers. The reports are chiefly taken from those given in the columns of the *Times*.

"MECHANICAL PATHOLOGY CONSIDERED IN ITS RELATION TO BRIDGE DESIGN."

This was the title of a paper by Mr. G. H. Thomson, read for the author by Mr. B. Baker in Section G. (Mechanical Science). After pointing out the applicability of the ordinary terms of medical science in the consideration of mechanical problems, the author asked, How many railway bridges are structurally competent to perform the work for which they were erected? How many are being taxed mechanically beyond the limit ever intended? And how many are able to withstand the sometimes rough usage (as in the case of collisions) incidental to railroad operations? A railway-bridge was ordinarily constructed upon the assumption that all the conditions governing its use and life would always remain favourable, and the non-recognition of the fact that an unfavourable combination of circumstances might occur was responsible for many of the deficiencies that occurred in practice. No fewer than 251 truss railway-bridges had failed in the United States and Canada during the ten years ending December, 1887, from preventable causes such as were alluded to, involving in each case the wreck wholly or partially of a train. The author investigated the causes of these several accidents under different headings. He discussed successively broken axles and wheels, increase of tonnage, power, and speed. He doubted the utility of laboratory tests as a means of affording thoroughly reliable information in regard to broken axles, and pointed out that whereas the earliest engine used in America only weighed 0·875 ton per wheel, those now in use weighed 8 tons and upwards. Since 1874 the speed of freight trains on the New York Central had increased from 15 to 25 miles per hour, and passenger trains at times attained a maximum speed of no less than 74 miles an hour. The author then discussed certain experiments he had made with a view to ascertain the strains that occurred in various types of bridge when loads passed over them, and proceeded to describe an extensive series of photographs illustrative of bridge accidents, which were exhibited to the meeting. In concluding he strongly advocated the use of riveted lattice bridges instead of pin-connected trusses for railway service up to spans of 250 ft., and gave numerous reasons for preferring them, as well as conditions to be observed in their construction.

UNDERGROUND WATERS.

Mr. J. Bailey Denton read a paper on "The Replenishment of the Underground Waters of the Permeable Formations of England," in which he said: The author, having long advocated with the late Sir John Rennie and others the storage of the surplus rainfall in reservoirs or lakes to be constructed in the higher tributary valleys of our river systems to maintain them in full service, invites attention to the capabilities existing of replenishing at the same time the subterranean supplies of the water-bearing strata by shafts to be sunk down to the line of their saturation. Of the 27 inches forming the mean average annual rainfall, about two-thirds, or 18 inches, are evaporated from the surface, while of the remaining third 4 inches serve to maintain the river system, and 5 inches pass away as floods and freshets. Instances are numerous in which the year's rainfall exceeds 30 inches, while they are very few in which it is less than 20 inches—about three times in twenty years. As the amount of evaporation is nearly a constant figure, and the quantity required to maintain effectually the river system necessarily remains the same under all conditions, the amount of flood or excess water greatly varies. It is sometimes double the average. On the few occasions when the rainfall does not reach 20 inches it is insufficient to satisfy the demands of the river system, and then the river becomes a borrower from the stored supply of the subterranean reservoirs. On such occasions the quantity of water flowing down the Thames to Kingston has been so reduced as not to reach 300 million gallons in 24 hours. The importance and bearing of this fact upon the proposal to replenish the subterranean supply will be appreciated when it is pointed out that the quantity of water supplied daily to the metropolis by the water companies has already exceeded 150 million gallons. Of these 150 millions the River Thames contributes 50 per cent., or 75 millions, which is a quarter of the quantity flowing past Kingston. The Lea furnishes 38 per cent., and deep chalk wells the remainder, or 12 per cent. The quality of deep-well waters has become of late years more and more approved. Dr. Edward Frankland, in his classification of potable waters, places deep-well waters only second to springs issuing from the outcrops of the same formations. To make good the loss of this superior water, the author proposes that whenever the water in the river rises above a certain datum height recognised as the gauge of its full service, the excess shall be diverted out of the river course on to filter-beds formed near at hand. The outlet from these filter-beds would be steined shafts or sumps sunk down to the water level beneath, and into them the filtered water would pass after it was freed from flocculent matter. The steined shafts would be made water-tight, and sealed against all surface contamination.

LIGHT OR ROAD RAILWAYS.

"A Few Arguments in Favour of Light or Road Railways" was the title of a paper read by Mr. T. S. Sellon before Section G (Mechanical Science). The author's object was to demonstrate that there was no reason why the present tramway system, familiar in most of our principal towns, could not be made (with some modifications) of exceptional value as feeders to the trunk lines, and as a means of transit for every description of goods and merchandise as well as passengers. By utilising the sometimes considerable waste, so often met with along the side of our country roads, cheap and efficient feeders could be constructed, thereby saving the cost of land purchase, or the heavy cost of maintenance if constructed on the road. A line which had been constructed on this principle, and which had been working for the last eighteen months, was mentioned, as proving how increased facilities made increased traffic. It carried the entire population of the whole district once a week, besides dealing with the whole of the cartage and delivery of goods to and from the London and North-Western Railway, with which the line was connected, as well as all the parcels and mails. Besides the advantages proved by the large patronage it received, the property in the district since its opening had risen 20 per cent. in value, and houses which had long been in want of tenants were now all occupied. As the object of this class of railway was to carry heavy goods and other merchandise that would otherwise be drawn along the road, it was clear that there must be a great saving in the wear and tear of the same, as well as a material relief to the road rates, which, in some country districts, were a great burden. Being a tramway, the working expenses, as compared with railways, were very small, owing to the absence of stations and station officials, signals, and telegraph. The author was strongly against the construction of this class of light railway to any other gauge but that of the line it fed, as he affirmed that the plea of economy could not in that case be maintained, and that one of

the chief causes of the failure of the Irish Tramway Act, 1883, was the fact that the gauge was fixed at 3 ft., the fallacy of which had been demonstrated by the report of the late Royal Commission on Irish Public Works. He also pointed out the great necessity there was for the reform of Private Bill legislation, there being far too much expense in the introduction of a scheme,—*i.e.*, prior to consideration; a mutilated Bill being often accepted by the promoters in consideration of the money already expended. In these days of progress landowners were urged to thoroughly examine the merits of a scheme before they threw away their money in opposition, as by arrangement with promoters all their objections might often be overcome. By a comparison between the ordinary service of a branch line and the ordinary service of a light railway, it was demonstrated by the actual returns of the latter that it was to the interest of all railway managers and railway shareholders to give every facility for the construction of these feeders, which must largely increase the value of their properties.

Mr. Shelford thought the great difficulty in the way of light railways in this country was the want of legislation. At this moment, farmers were unable to obtain those light railways because Parliament had not afforded the legislation in order to accommodate them. There were no means available at present in this country of obtaining power to make a really light railway. In our colonies, however, and elsewhere, there was a wide field for those lines of railway.

Mr. Wheeler bore testimony to the advantage which the farmers of this country would derive in the conveyance of produce were light railways constructed. It was desirable, however, that there should be no break of gauge between the main lines and the subsidiary ones. Holland and Belgium were able to send cheap vegetables into this country, owing to the traffic facilities which they enjoyed.

Another speaker thought that an increase in the small branch railways would have an enormous effect in preventing aggregation of the working population.

THE ELECTRICAL TRANSMISSION OF POWER.

This was the subject of one of the evening discourses delivered at Bath during the recent meeting of the British Association. The discourse was very fully illustrated by apparatus and by views thrown on a large screen.

The lecturer, Professor Ayrton, F.R.S., said,—What is power, and why should we wish to transmit it? Power has one very definite meaning in science and several rather vague meanings in practice. We speak of a powerful athlete, the power of the law, we sing of the power of love, and we say that knowledge is power. But by "power" an engineer understands the rate of doing work. When you walk upstairs you exert power, only perhaps the one-twentieth of a horse when you go up slowly talking to other people. But when you run upstairs because you have forgotten something that you intended to bring down, then your exertions represent perhaps the one-tenth of a horse-power. You only get to the top of the stairs in either case, but the breathless sensation of running fast upstairs tells you that the more quickly you go the harder you are working. A person exercises power in the engineer's sense when he exerts himself physically, and the greater the exertion the greater the power. Probably the most familiar example of exerting power at a distance, that is of transmitting power, is pulling a handle and ringing a bell in another room. It was not until just 100 years ago that it dawned on people that if one person, A, wanted to attract the attention of another person, B, the place where the bell ought to sound was where B was and not where A was. Indeed, in many English villages down to the present day the knocker principle of attracting attention is alone resorted to, with the result which you may remember happened when Mr. Pickwick was staying in Bath at lodgings in the Royal-crescent. But if some houses can still dispense with mechanical or other methods of transmitting power even to ring bells, factories cannot. The looms, the lathes, or whatever the machinery used in the factory may be, must either be worked by hand or foot in the old style, or must be connected with the steam, gas, or water-engine in the new. In America there are 6,000 electro-motors working machinery; in Great Britain hardly 100. The holiday tourist, when admiring the splashing water dashing over the stones, hardly realises that the money loss is as if the foam were composed of flakes of silver. The newspapers of last week contained a long account of the spiral electric mountain railway that has just been opened to carry people up the Burgenstock, near Lucerne, and worked by the River Aar, three miles away, so that we see that electric traction worked by distant water-power is extending. But splendid as are these most successful uses of water-power to actuate distant electro-motors, it is but a stray stream here and there that has yet been utilised, and countless wealth is still being squandered in all the torrents all over the world. A general supply of power to workshops is to the manufacturer what a general supply of light or a general supply of post-office facilities is to the householder; it is all part of the steady advance of civilisation that leads the man of to-day to go to the tailor, the shoemaker, the baker, the butcher, instead of manufacturing his own mocassins and lassoing a buffalo for dinner. And in case any of you may be inclined to think that we have gone far enough in these new-fangled notions,—and we are all, perhaps, prone to fall into this mistake as we grow older,—let me remind you that, while each age regards with justifiable pride the superiority of its ways to those of its ancestors, that very age will appear but semi-civilised to its great-grandchildren. Let us accept as an undoubted fact that a general distribution of power would enable the wants of civilised life to be better satisfied, and, therefore, would greatly benefit industry.

There are four methods of transmitting power to a distance:—1. By moving a rope. 2. By air compressed or rarified at one end of a pipe operating an air-motor at the other end. 3. By water forced through a pipe working a water-motor. 4. By electricity. We have an example of the transmission of power through a short distance by an endless belt or rope in the machines geared together by belts on this platform, and in the rotatory hair-brushes at Mr. Hatt's establishment in the Corridor Bath. At Schaffhausen, and elsewhere in Switzerland, the principle is employed on a large scale. Spain and other countries use it in connexion with the mining operations, and lastly wire ropes replace horses on many hilly tramways. For short distances of a mile or so there is no system of transmitting power in a straight line along the open country so cheap to erect and so economical of power as a rapidly-moving endless rope; but the other systems give much greater facilities for distributing the power along the line of route, are much less noisy, and far surpass wire-rope transmission in economy when the rope must move somewhat slowly, as in tramway traction, or when the distance is considerable over which the power is transmitted, or when the line of route has many bends. The electric transmission of power even now bids fair to surpass all other methods in—1. Economy in consumption of fuel. 2. More perfect control over each individual machine. 3. Ability to bring the tool to the work instead of the work to the tool. 4. Greater cleanliness,—no small benefit in this dirty, smoky age. 5. And lastly, there is still one more advantage possessed by this electric method of transmitting power that no other method can lay claim to—the power which during the day-time may be mainly used for driving machinery can, in the easiest possible way, be used during the night for giving light.

Our knowledge of electrical action in this respect resembles our knowledge of gravitation action. The only thing quite certain about the reason why a body falls to the ground is that we do not know it; and yet astronomical phenomena can be predicted with marvellous accuracy. The power of producing an action at a distance of many yards, or it may be many miles, by the aid of electricity without the visible motion of any substance in the intervening space is by no means new. It is the essence of the electric telegraph, and electric transmission of power was employed by Gauss and Weber when they sent the first telegraph message. But until about ten years ago the facility that electricity gave for producing signals almost instantaneously at a great distance was the main thing thought of. The electric power consumed for sending the telegraph messages was so small, the amount of power lost *en route* comparatively so valueless, that the telegraph engineer had no need to trouble himself with those considerations that govern us to-day when we are transmitting power large enough to work a factory or an electric tramway. Although there are as many as 22,560 galvanic cells at the Central Telegraph Office, London, which cost some thousands annually to keep in order, what is that compared with the salaries of all the 3,089 superintendents, assistants, telegraph clerks, messengers, and the maintenance of the 1,150 telegraph lines that start from the central office? Until 1870 the pump most generally employed for pumping up electricity and giving it pressure was the galvanic battery, scientifically an extremely efficient converter of the energy in fuel into electric energy; but, unfortunately, the only fuel a battery will burn is so expensive. A very perfect fireplace in which there was very complete combustion and very little loss of heat, but which had the misfortune that it would only burn the very best wax candles, would be analogous with a battery. Suppose, however, a process be devised by means of which burnt zinc can be unburnt with an expenditure comparable with the burning of the same weight of coal, then it might be that, although coal would still form the basis of our supply of energy, the consumption of zinc in batteries might be an important intermediary in transforming the energy of coal economically into mechanical energy. While, then, some experimenters are aiming at possibly increasing the working power of a ton of coal to eight times its present value by earnestly seeking for a method of converting the energy it contains directly into electric energy without the intervention of a wasteful heat engine, it should not be forgotten that in the cheap unburning of oxidised metal may lie another solution. The solution of this latter problem is quite consistent with the principles of the conservation and dissipation of energy, since the heat required to theoretically unburn 1 lb. of zinc is only one-seventh of that given out by the burning of 1 lb. of coal. A very great improvement in electro-motors was made by Pacinotti in 1860, but, although his new form of electro-motor was described in 1864, it attracted but little attention, probably because any form of electro-motor, no matter how perfect, was commercially almost useless until some much more economical method of producing electric currents had been devised than the consumption of zinc and acids. A point to consider is the loss of power on the road between the dynamo at the one end and the motor at the other. This problem was, perhaps, seriously attacked for the first time in the discussion of a paper read by Messrs. Higgs and Brittle at the Institution of Civil Engineers in 1878, and that problem was considered in some detail theoretically and experimentally at the lecture I gave during the meeting of the British Association in Sheffield in the following year. It was then shown that, since the power developed by the generator and motor depended on the product of the current into the electric pressure, while the loss when power was transmitted through a given wire depended on the square of the current and was independent of the electric pressure, the economical transmission of power by electricity on a large scale depended on the use of a very large electric pressure and a small current, just as the economic transmission of much power by water depended on the use of a very large water pressure and a small flow of water. At that time it was not thought possible to construct a small dynamo to develop a very large electric pressure, or potential difference, as it is technically called, and, therefore, it was proposed to join up many dynamos in series at the one end and many lamps or electro-motors in series at the other, and to transmit the power by a very small current, which passed through all the dynamos and all the lamps in succession, one after the other. We laugh a good deal at the rough and ready manner adopted on the other side of the Atlantic. The Americans, no doubt, are very ignorant of the difficulties that properly-minded people would meet with, but it is a blissful ignorance where it is folly to be wise. Every English electrician who has travelled in America comes back fully impressed with their enterprise and their happy-go-lucky success. They have twenty-two electric tramways, carrying some 4,000,000 passengers annually, to our four electric tramways at Portrush, Blackpool, Brighton, and Bessbrook. Why, New York City alone, Mr. Reckenzaun tells me, possesses 300 miles of ordinary tramway track, and Philadelphia City 430 miles; so that there is more tramway line in these two cities than in the whole of the United Kingdom put together. But it is possible to use a very large potential difference between the main wires by means of which the electric power is economically conveyed a considerable distance

and transformed into a very small potential difference in the houses where it is utilised. A vast district in London, extending from Regent's Park on the north to the Thames on the south, from the Law Courts on the east to Hyde Park on the west, has over 20,000 incandescent lamps scattered over it, all worked from the Grosvenor Gallery in Bond-street by means of alternate current transformers, which convert the 2,000 volts maintained between the street-mains into 100 volts in the houses, and this London Electric Supply Company have arranged for a vast extension of this system to be worked from Deptford. In America alternate current transformers are, due to the remarkable enterprise of Mr. Westinghouse, used to light 120,000 incandescent lamps in sixty-eight towns. In fact, the electric lighting of a whole town from a central station begins to excite less astonishment than the electric lighting of a single house did ten years ago. The efficiency of a well-made alternate current transformer is very high, being no less than 96·2 per cent. when the transformer is doing its full work, and 89·5 when it is doing one quarter of its full work, according to the experiments made by our students. It certainly does seem most remarkable, and it reflects the highest praise on the constructors of electrical machinery, that motor power can be converted into electrical power, electrical power at low pressure into electrical power at high pressure, or electrical power at high pressure into electrical power at low pressure, or, lastly, electrical power into motor power; in each case with an efficiency of 94 per cent. As a further illustration of the commercial importance of this electric transformation, I will show you some experiments on electric welding, one of the latest developments in electrical engineering. To weld a bar of iron one square inch in section requires a gigantic current of some 13,000 ampères. To convey this current even a few yards would be attended with a great waste of power, consequently, while an enormous current is passed through the iron to be welded, only a comparatively small current is transmitted along the circuit from the dynamo to the welding apparatus. During the last few months fierce has been the battle raging among the electricians, the war cry being alternate current transformers *versus* accumulators, while the lookers on, with that better view of the contest that they are proverbially said to possess, have decided that the battle is a drawn one. Neither system is the better under all circumstances; if the district to be lighted be a very scattered one, use alternate current transformers by all means; but if the houses to be lighted are clustered together at a distance from the supply of power, then the storing property possessed by accumulators, which enables the supply of electric power to far exceed the capacity of the dynamos and engines in the busiest part of the twenty-four hours, will win the battle for accumulators. Any direct current system of distribution such as is furnished by accumulators has also the very great advantage that it lends itself to the use of the very efficient electro-motors which I have been using this evening. Alternate current motors do exist, but they are still in the experimental stage, and are not yet articles of commerce. I showed you a little while ago an electric fire. Was that a mere toy, or had it any commercial importance? To burn coal, to work dynamos, and to use the electric current to light your houses and your streets is clean and commercial; to use the current to warm your rooms, clean but wasteful, on account of the inefficiency of the steam-engine. But when the dynamos are turned by water power, which would otherwise be wasted, the electric current may be economically used, not merely to give light, but also to give heat. And when the electric transmission of power becomes still more perfect than at present, even to burn coal at the pit's mouth, where it is worth 1s. a ton, may, in spite of the efficiency of the steam-engine being only one-tenth, be the most economical way of warming distant towns where coal would cost 20s. a ton. Think what that would mean—no smoke, no dust, a reform effected commercially which the laws of the land on smoke prevention are powerless to bring about; a reform effected without the intervention of the State, and therefore dear to the hearts of Englishmen. But of all the many commercial uses to which the electric current may be put, probably, after the electric light, electric traction has most public interest. Now, while it costs 6d. or 7d. to run a car one mile with horses, it only costs 3d. or 4d. to propel it electrically. Indeed, from the very minute details that have recently been published of the four months' expenses of electrically propelling thirty cars at seven and a half miles an hour along twelve miles of tramway line in Richmond, Virginia, it would appear that the total cost, inclusive of coal, oil, water, engineers, firemen, electricians, mechanicians, dynamo and motor repairers, inspectors, linemen, cleaners, lighting, depreciation on engine, boiler, cars, dynamos, and line work has been only 1¼d. per car per mile. The "series" system of propelling electric trains was, oddly enough, entirely ignored in all the discussions that have taken place this year at the Institution of Civil Engineers and at the Institution of Mechanical Engineers regarding the relative cost of working tramways by horses, by a moving rope, and by electricity, and yet this series system is actually at work in America. There is a series electric tramway in Denver, Colorado, and a series electric tramway twelve miles long, on which forty cars are to be run, is in course of construction in Columbus, Ohio. The first track on which electric trams were run in series was the experimental "Telpher line," erected at Glynde in 1883, under the superintendence of the late Professor Fleeming Jenkin, Professor Perry, and myself, for the automatic electric transport of goods. The Series Electrical Traction Syndicate are now developing our idea, but it has received its greater development in the States, where the Americans are employing it instead of spending time proving, *à priori*, that the automatic contact arrangements could never work. In addition to the small waste of power, and consequent diminished cost of constructing the conductors that lead the current into and out of the passing trains, the series system has another very marked advantage. Some years ago we pointed out that when an electric train was running down hill, or when it was desired to stop the train, there was no necessity to apply a brake and waste the energy of the moving train in friction, because the electric motor could, by turning a handle, be converted into a dynamo, and the train could be slowed or stopped by its energy being given up to all the other trains running on the same railway, so that the trains going down hill helped the trains going up hill—the stopping trains helped the running trains. At that time we suggested detailed methods for carrying out this economical mutual aid arrangement, whether the trains were running on the parallel or on the series system. But there is this difference—that, whereas on the parallel system it is only when a train is running fairly fast that it can help other trains, the series system has the advantage that, when a motor is temporarily converted into a dynamo by the reversal of the connexions of its stationary magnet, the slowing train can help all the other trains, even to the very last rotation of its wheels. Brakes that save the power instead of wasting it are of purely English extraction, but their conception has recently come across the Atlantic with such a strong Yankee accent that it might pass for having been born and bred in the States. Economy is one feature that gives electric traction their right to claim your attention, safety is another. This model telpher line, worked on "the post-head contact" system, is so arranged that no two trains ever run into one another, for in addition to each of the three trains being provided with an automatic governor which cuts off electric power from a train when that train is going too fast, the line is divided into five sections connected together electrically in such a way that as long as a train is on any section A, no power is provided to the section B behind, so that if a train comes into section B it cannot move on as long as the train in front is on section A. (Three trains were shown running on a model telpher line with four automatic locks.) Whenever a train—it may be even a runaway electric locomotive—enters a blocked section, it finds all motive power withdrawn from it quite independently of the action of signalmen, guard, or engine-driver, even if either of the latter two men accompany the train, which they do not in the case of telpherage; no fog, nor colour-blindness, nor different codes of signals on different lines, nor mistakes arising from the exhausted nervous condition of overworked signalmen can with our system produce a collision. Human fallibility, in fact, is eliminated. It may be interesting to mention that the last difficulty in telpherage, which consisted in getting a proper adhesion between the driving-wheels of the locomotive and the wire rope, has now been overcome. The history of telpher locomotives is the history of steam locomotives over again, except that we never tried to fit the electric locomotives with legs, as was proposed in the earlier days for steam locomotives. It is a tedious, discouraging history; but it is so easy to be wise when criticising the past, so difficult to be wise when prospecting the future. Gripping wheels of all kinds, even the indiarubber tires used for the last three years, have all been abandoned in favour of simple, slightly loose, cheap iron tires, which wear for a very long and give a very perfect grip when the bar supporting the electro-motor is so rivetted, pendulum-wise, to the framework of the locomotive that the weight of the motor no longer makes the locomotive jump in passing the posts, as it did until quite recently. After several years of experimenting we have in telpherage, I venture to think, at last a perfectly trustworthy and at the same time a most economical method of utilising distant stream or water power to automatically transport our goods, and in time it may even be our people, over hills and valleys without roads or bridges and without interfering with the crops or the cattle, or the uses to which the land may be put over which the telpher trains pursue their snake-like way; we have, in fact, the luxury of ballooning without its dangers.

LONDON SCHOOL-BOARD COMMITTEE.

SIR,—I cannot see an architect under whom I served in 1874 assailed without joining the fray.

If ever a captain sailed with a scratch crew, Mr. Robson did at that date. He had only two competent assistants, viz., Mr. Bailey and Mr. Macfarlane, and the latter's duties were secretarial, not architectural.

The story of the twin staircase referred to in your article in last number, is a very old one. It used to be related at every meeting when the clerks of works met at the Bank of England monthly to receive their pay. I have heard it dozens of times at that date, with variations, but then it was a clerk of works at a school at Clapham that figured as the hero, and Mr. Robson was stated to have called him a fool to his face, and I always said "serve him right."

I am speaking from memory of drawings that passed through my hands fifteen years ago, and am subject to correction, but these stairs were a clever attempt to utilise space, getting two stairs in the superficial area of one, and a mezzanine floor over a coal-place to be used as a lavatory. The height from floor to ceiling being only 15 ft., it is clear that only 6 ft. 6 in. from the top of the lower step to the soffit of the one over could be obtained. Only eighth-scale drawings were supplied, and any clerk of works worth his salt would have done as I did,—make an inch-scale drawing, as very careful working was required to get the head-room regular.

A word in defence of the clerks of works. The Board's system of giving monthly payments on account to builders enabled a very impecunious lot to get schools to build. The clerks of works were given several schools, and they could not watch everything. As an illustration, a builder of one of the five schools given me to superintend was given the materials of an old cottage bought to enlarge the playground. I had been absent all the morning of one day, and, on arriving at the school, found the cottage gone. The foreman, with a smiling face, told me they had a lot of carts early, and carted it all away. He looked too happy, and, on looking the building over, I found a long and deep trench to the infants' school filled and nicely levelled up with concrete, ready to receive footings; but, on removing the top six inches, I found the grave of the old cottage, old bricks, plaster, and rubbish filled in the centre of the trench, and a little concrete plastered up the sides and bottom and over the top. I need not say there was a row till it was all taken out. If I had not discovered it, under the present feeling I should have been declared dishonest.

I think Mr. Robson was tripped by Mr. Christian's question, as all his specifications at the date I mention were for "joints of brickwork to be struck as the work proceeds." Builders were always asking to be allowed to point down on completion, and Mr. Coombe gave them consent, I believe without Mr. Robson's knowledge.

I have examined some hundreds of old brick buildings of the date of Queen Anne and the Georges, but have never found *tuck* pointing except as a repair. The joint used is the same in nearly all cases; thus, the joint is struck full and flat, level with the face of the brick, with the trowel, a jointer about a quarter-of-an-inch wide is then drawn along a straight-edge, leaving a slight groove about one thirty-second of an inch deep and a quarter-inch wide.

The strings and arches are always of orange-coloured bricks, guaged and set with a very close joint in lime putty and silver sand, and the joint

ironed full and flat. This white joint sets like cast iron.

Tuck pointing is a decided mistake.

ROBERT PHILLIPS.

10, *Brook-street, Gloucester.*

OLD COTTAGE ARCHITECTURE.

SIR,—I am not one of those who object to the simpleness of the old cottages now being illustrated in your pages; and when the papers are completed I should be glad to see them separately published in a correspondingly simple and inexpensive form. The plans and diagrams, with the letterpress, are especially interesting. The sketches would, I venture to think, be more useful if they were given chiefly in outline, with some of the main dimensions, at any rate, figured upon them.

In the plans, Mr. Nevill seems to have made rather a leap from the one-roomed cottage to a good-sized house (Rake House). I hope he will not forget the numerous old parsonages that remain,—now usually in the occupation of the parish clerks. In Kent and Sussex they are all of nearly the same plan and external appearance, containing a good-sized living-room, with two cellars or offices at one end, and two rooms above. Query,—What might their date have been? That they were originally occupied by the parish priests is, I think, tolerably certain, not only from tradition, but because the early stone-built parsonage at West Dean, near Eastbourne, which has some architectural pretensions, is of a precisely similar plan.

I cannot say I quite agree in the propriety of stripping the rough-cast which may now cover a timber cottage, when that proceeding is NOT necessary for repairs. I confess that to my mind the Staples Inn houses looked more "clothed and in their right mind" as they were. R. C.

ANCIENT STONE CROSS FOUND AT GLOUCESTER.

SIR,—A glance at the views of an ancient cross found at Gloucester proves it to have been the work of Irish hands, without the confirmatory evidence furnished in Mr. Medland's letter.

He states that St. Oswald lived at Iona, which monastery was founded by the Irish saint Columba, or Columbkille, who was born A.D. 521, and was one of the earliest Irish missionaries from Ireland,—or, as it was then called, Scotia,—to England.

The Irish monks brought Irish artificers with them, and there are two round-towers and the remains of numerous crosses covered with Celtic ornament which prove the truth of the Irish annals, which record the missionary work done by the Irish monks in England long prior to the arrival of St. Augustine in A.D. 590.

The ornament on the Gloucester cross and the so-called Saxon crosses found at Peterborough, and illustrated in the *Builder* for August 25, is identical with that found on the crosses at Monasterboice, Glendalough, Clonmacnoise, and several other places in Ireland. Archæologists have often been mistaken in attributing such work to Saxon hands, and I think that a careful examination will show how widely such Celtic remains are distributed through England. I have myself seen two Celtic crosses in the churchyard of Leek, in Staffordshire; and when on the A. A. Excursion last month in Derbyshire, came across the remains of a Celtic cross in the churchyard at Bradbourne, and a large number of beautifully-carved crosses and tombstones covered with Celtic interlaced ornament and Byzantine-like crosses in the porch of Bakewell Church, where they have been deposited, having been found built into the walls on the restoration of the church some years ago.—Yours, &c.,

JOHN L. ROBINSON.

148, *Great Brunswick-street, Dublin.*

Sept. 19, 1888.

CHURCH BUILDING NEWS.

Clyst St. George, Exeter.—A short time ago the new additions recently made to the chancel of the parish church of St. George, at St. George's Clyst, were for the first time used for Divine service. The new work consists of a vestry, choir, and organ chambers on the north-east end, porch and small transept on the south side, new chancel fittings and screens, and enlarged organ. The new masonry is of red Heavitree stone, with Bath stone dressings, and pitch-pine is used for the timbers of the roofs and the vestry fittings. The vestries and transept open into the chancel, and are divided therefrom by arcades of masonry. These arcades contain three parclose screens of English oak, surmounted by pierced crusting. The screens are the work of Mr. Harry Hems, of Exeter, and also two new priest's desks of carved oak and carved bench-ends to the enlarged stalls. The general contractors were Messrs. J. L. and H. Steer, of Clyst St. George, and the architect was Mr. Robert Medley Fulford, of Exeter.

Colchester.—The upper part of the tower of St. Leonard's Church, Colchester, is being rebuilt, and portions of the church restored, by Mr. L. J. Watts, mason, of Colchester, the detail, except some portion found embedded in the eighteenth-century work, being designed by Mr. W. Scargill, architect, of the same town. We are informed that the original design is being followed as nearly as possible from the best ascertainable authorities. The portion of the tower rebuilt contains four three-light Perpendicular louvre windows, over which is a frieze and graduated battlement, with a small turret at each angle, and four lesser-sized windows over in the centres of the four sides. The tower is faced with rubble with Combe Down dressings, and the parapet faced with black flint.

Newton Heath.—The Bishop of Manchester consecrated the new Church of St. Augustine, Newton Heath, Manchester, on the 12th inst. The church, which has only lately been completed, will accommodate 540 persons, and is built of red pressed bricks, the mouldings and tracery work being of Ruabon terra cotta. Early English Gothic is the style of architecture adopted, the nave being 44 ft. wide and 96 ft. long. The north transept is temporarily used for a vestry, the south transept being arcaded only, with a view to future extension. The chancel is 25 ft. wide, but is only 10 ft. in length at present, the choir stalls, pulpit, and reading-desk being placed on a raised platform in front. Future extension will be met by the erection of a south transept, the completion of the chancel, and the building of a vestry. The whole of the internal fittings, roof timbers, vestibule framing and doors, pews, pulpit, and communion rail are of varnished pitch pine. The floor of the church is laid with wood blocks, and the chancel and aisles are tiled. The church is ventilated by means of Boyle's ventilators on the roof, connected by galvanised iron tubes with the various ceiling ventilators. Hot-water pipes are fitted for heating purposes. The total cost, including boundary fences, laying out of the ground, fittings, and furniture is 4,000*l.* Mr. A. W. Smith, of Manchester, was the architect, and Mr. George Macfarlane, also of Manchester, was the contractor.

Northstoke.—The restoration of the little church at Northstoke (says the *Bath Chronicle*) has added another link to the chain that binds the city of Bath to Roman times. In addition to the exposure of a supposed Saxon sun-dial, further interesting discoveries have been recently made. The church, it is generally known, is situated close to the Roman Via Julia, which led from Bath to Caerleon, and on a portion of a Roman Villa, that, judging from fragments which have been found, must have been one of the largest in the neighbourhood. Its architecture probably even excelled that of those at Newton St. Loe and Wellow. In the work of restoration fragments of pottery have been found embedded in the walls, which lead to the belief that the church is of the most ancient foundation; indeed, it has been surmised from an inscription on the wall that it must have been a Christian edifice in Roman times. The chancel arch, instead of being set at right angles to the wall, is at an oblique angle, and built of very large stones, placed somewhat in the way that is known as "long-and-short" courses. The system of masonry, instead of being circular, leads to the belief that it was "blunt-pointed." At the side of the arch have been found the steps which lead to a rood loft. These were formerly hidden by the pulpit, which used to be on the south, and has now been removed to the north, and above them has been discovered the doorway which led to the loft itself. Here a notch in the stone shows the precise line of the loft. The church appears to have fallen into partial ruin some time after the Restoration, but was formerly a cell of Bath Abbey. Its architecture, with the exception of the porch and a buttress of the tower, justifies the belief that it was re-established about the time of Laud, or rather when he was bishop of the diocese previous to his translation to Canterbury. The old pews were of that date, and in the restoration the same pattern has been followed. To harmonise with this, the stalls of the chancel and the lectern have been made in the same style. The east window is entirely new, and in it has been placed the stained glass about which so much was heard recently in connexion with St. Saviour's Church. Major Davis has been the architect for the new work, which has been carried out by Messrs. W. Cowlin & Sons, of Bristol. The church was reopened on the 7th inst.

Plymouth.—The Bible Christian Chapel in Zion-street, Plymouth, which has been closed for alterations and repairs, was re-opened on the 12th inst. The old side and end galleries have been taken down and replaced by galleries of a more ornamental character, and the narrow pews, both in the body of the chapel and the galleries, have given place to open pitch-pine benches. Among other improvements are the lowering of the rostrum, the painting and re-decorating of the walls, and the fixing of ornamental gas brackets and pendants. Mr. H. J. Snell, of Plymouth, was the architect, the contractor being Mr. J. J. Marshall, also of Plymouth.

Rockwell-green, Wellington.—The foundation-stone of the new church of All Saints, Rockwell-green, Wellington, was laid on Monday, the 10th inst. The building will consist of a lofty nave with clearstory, 44 ft. high to the point of the roof, north and south aisles, chancel, north and south transept, and a vestry adjoining the north transept. A chamber for the warming apparatus will be built under the vestry. The tower, which is shown in the design, but which, as stated, is not included in the present contract, will be on the south side of the church, and the lower stage will form the main south entrance. The style of the building will be of the transition period from the Early English to the Decorated. The windows will be chiefly lancets, but the east window of the chancel is to be of three lights with tracery head. The walls are to be built of local red sandstone, laid on random courses, lined internally with brick and Hambdon-hill stone dressings. The roofs are to be covered with Staffordshire tiles, and the tower will be covered with a flat lead roof. The interior walls, to the height of 3 ft. from the floor, will be cased with red brick-work, above that line with brick-work of various colours. The pillars supporting the nave arcades will be of Hambdon-hill stone, and the arches will be of coloured brick-work. The roofs will be open-timbered, with tinted plastering between the rafters, except in the chancel, where the rafters are to be covered with boarding. The floors of the passages will be paved with tiles, also the whole of the chancel; but the floors under the seats are to laid with wooden blocks or concrete. The church is to be fitted with open benches of pitch-pine. The chancel stalls will be of similar material, and the font and pulpit will be of Hambdon stone. The windows will be glazed with tinted Cathedral glass in lead-work, and the warming will be effected by means of water-pipes. Provision will be made for lighting the church by a row of gas-jets round the abacus of each pier of the nave arcade, and in the chancel there will be a corona suspended from the apex of the roof. It is estimated that the church will accommodate 450 people. The contract for the erection of the building, exclusive of the tower, amounted to nearly 3,000*l.* The architect is Mr. J. H. Spencer, of Taunton.

Stockland.—The parish church of Stockland, near Honiton, has just been reseated, with the exception of the chancel and the north chancel aisle. Moulded open benches of pitch-pine have superseded the high pews, the floors under the seats have been laid with wood blocks, and the passages have been re-arranged. The choir seats and prayer-desks have also been improved, and the chancel floor laid with Godwin's tiles, while a new oak Communion-rail has been fixed,—all to the architect's design. The Perpendicular font has been re-fixed on a Keinton stone platform in the tower. The east end of the north chancel aisle has been divided off by an ornamental wood screen to form the vestry, as it was originally, evidenced by the position of the formerly blocked-up doorway, now opened out. The south porch (till lately the vestry) has been restored, as it had been much mutilated, and brought back to its original object. The church is now warmed on Porritt's system of underground stoves. The architect was Mr. B. Edmund Ferrey, F.S.A., and the builder Mr. W. T. Berry, of Honiton.

SCHOOL-BUILDING NEWS.

Twerton.—On the 11th inst. the Bishop of Bath and Wells dedicated the Sunday-schools, Parish Club-room, and Gymnasium, just erected in connexion with St. Peter's, East Twerton, Bath. The building has been erected from the designs of Mr. E. Buckle. The principal room, which will be used for Sunday-school and parish

gatherings, is 64 ft. by 32 ft., and is lofty and well lighted. Adjoining is a reading-room, about 30 ft. by 24 ft., and there is another large room which is to be used for a library. Three large rooms on the first floor will be devoted to other purposes in connexion with parochial work. Mr. J. Long was the builder, and the cost has been upwards of 3,000*l*.

Bristol.—Some new schools were opened at Bristol on the 14th inst., which have been erected in the Easton-road for the Bristol School Board. The schools, which are in the Gothic style of architecture, and are built of grey Pennant-stone, with freestone facings, consist of a central block and two wings. In the former are eight school or class rooms, four on each floor, each room being 29 ft. by 25 ft. 6 in. These are capable of accommodating a total of 500 children, in four divisions. The four class rooms on each floor can, by means of glazed sliding screens, be thrown into one, making the whole one large room, 58 ft. by 51 ft. The rooms on the ground floor are 14 ft. high in the clear; those on the upper floor average 15 ft. high, being 12 ft. at the sides and 17ft. in the centre. They are well lighted by large windows in front and behind. The entrances for the infants are on each side, adjoining the central block. Those for the older children are at the extreme ends, opening into staircases 11 ft. wide, with steps 5 ft. long of an easy gradient, each step being 1 ft. wide with a riser of 6 in. Commodious rooms for the convenience of the teachers are situated in each wing, and latrines are provided in separate buildings, with lobbies of communication from the landings and staircases of each of the four divisions. There are two playgrounds in the rear, each 60 ft. by 48 ft., containing 640 square yards, laid with spar-faced asphalte paving, one-third of which is covered with play-sheds. The whole of the floors and roofs of the central block of the building are supported by a single column of cast-iron, which is also designed to receive the ends of the four screens when closed. The upper floor is primarily supported by a large box girder extending from front to back, and resting on the central pillar. To this main girder are attached six smaller girders at right angles to it, which in their turn support the wooden joists of the floor. The central pillar is also carried through the upper story to support in a similar manner the central girder on which the principals of the roof rest. This portion of the work has been carried out by Messrs. Sampson, engineers, of Bedminster. Heat is supplied to the schools by means of hot water on the system of Messrs. Skinner & Board, of Stoke's-croft. The ventilation has been executed by Messrs. R. Boyle & Son, of London. The architects were Messrs. Hansom & Bond, of Clifton, the contractor being Mr. T. R. Lewis, of Clifton-vale, and the clerk of works was Mr. George Downes.

The Student's Column.

ARTIFICIAL STONES.—XII.

Concretes (*continued*).

J. C. SELLAR'S patent process, brought out in 1874, is decidedly more sensible, though not particularly novel. In this case the artificial stone was made by subjecting to pressure a mixture of sand or other granular substances with Portland or other cement, powdered lime, or clay, which has been moistened with lime-water or water containing lime in suspension.

Greatorex & Hall, for their patent "ferrumite" stone (1876, patent 4,137), employ finely-ground and carefully-tested Portland cement of high quality, in combination with swamp sand, broken clinkers, stone, flints, shingle, gravel, or any other hard material; they then coat the blocks with a composition made as follows:—Portland cement is thoroughly mixed with iron filings, the mixture is then perfectly but slightly wetted and placed in the moulds before the body of the stone is set, or, instead of wetting the materials in the usual way, solution of sulphate of iron may be used. While in the moulds the composition is subjected to great pressure, and when quite set the block is placed in a bath of dilute sulphuric acid, which impregnates the body of the material, forming sulphate of iron, which is ultimately decomposed, as already explained, and renders the stone more durable.

G. Hodson, in his patent for the production of an artificial stone for making chimney-pieces, vases, columns, &c., directs that Portland, Roman, Keene's, or similar cements be mixed with granite, slag, gravel, broken stone, &c., and incorporated with dilute sulphuric acid, or, in some cases, with water only. The articles when dry are glazed and enamelled as may be necessary.

E. Schaffer's artificial stone is formed from a mixture of 1 part of cement and 3 parts of sand, made into a paste, with a two-per-cent. solution of sulphuric acid, and subjected to strong pressure. The stones are dried in the air for a couple of days, and then placed for twelve hours in a three-per-cent. solution of acid, and finally dried.

Westermeyer's artificial stone, at one time largely used in America, was formed of 2 parts of Portland cement, 1 part of sand, and 1 part of cinders, mixed together dry, and then moistened with an aqueous solution of sulphate of iron. The resulting mortar is pressed into moulds, dried in a warm place for two weeks, then placed in water for twenty-four hours, and finally dried in air for four weeks.

Quesnot employed a solution of 1 part of alum in 15 parts of water added to a mixture of 2 parts of hydraulic lime, 10 parts of sand, and 1 part of cement, to the required consistency, pressed into moulds, and allowed to remain for twenty-four hours. In fourteen days the stone will be ready for use, and will improve with age. Alum is here a decidedly effective addition, sulphate of lime, alumina, and probably a double sulphate of lime and potash being formed in the body of the stone.

W. J. Bennett's solution for increasing the hardness of concretes and artificial stones made from Portland or other cement was composed of a mixture of water, carbonate of soda, sal ammoniac (chloride of ammonium), and alum. We have already commented on the importance of a violent trituration of the concrete mixture, as being generally necessary to secure the best results, and we instanced J. Gibb's patent of 1850 as one of the earliest patented recognitions of this fact in this country. We must now return to this matter, and briefly deal with Coignet's processes, which have been so largely and successfully employed in France. A brief mention of the process only is necessary, as already in our columns, and in those of other journals, numerous and detailed reports have been given. In 1855 Coignet obtained his first patent in this country, followed by others in 1859, 1863, and 1869. In none of the published specifications are there any points of absolute novelty, and the wide success obtained for Coignet's béton (or concrete) was due to an intelligent combination of already well-known facts, and not to any revolutionary discovery. The secret of success is the manipulation of small quantities at a time of the concrete mixture, consisting of varying proportions of lime, cement, sand, gravel, stones, &c. (a favourite mixture being one of 5 parts of sand, 1 of lime, and 25 of hydraulic cement), with the smallest possible amount of water; these materials are pounded together, and when thoroughly incorporated placed in moulds, or in the position where they are to remain, and heavily rammed. A considerable diminution of volume results, owing to the expulsion of the air, and the effectual closing of the spaces between the component particles. The amount of this reduction of volume of course depends on the composition of the stone; in the case of the mixture above-mentioned it is as 1·7 to 1, and one cubic foot will weigh 140 lbs.

The concrete or béton soon hardens in the air, and is far more resistant to pressure, atmospheric and other influences, than is the ordinary material.

RECENT PATENTS.

ABSTRACTS OF SPECIFICATIONS.

13,786, Glazing, &c. J. W. Helliwell.

This invention has reference to a prior patent. In this improvement the glazing bar or astragal is somewhat in the form of a T, but made with three channels in the horizontal part, one in the centre thereof and one on each side. The vertical edges of the sheets of glass rest upon the opposite edges of the centre channel, but above or clear of the outer lip or edges of the two outside channels. In order to secure the sheets of glass, a cap is placed over the adjoining edges of the sheets, kept down by a set screw, which pierces the cap and passes through the space between the adjoining edges of the sheets and into a screwed hole in the bottom of the central channel of the bar. Thus, the sheets are held in position, whilst the several channels receive and collect the condensed or other water, which is afterward conveyed away by any suitable arrangement of pipes.

13,885, Manufacture of Paint. A. G. Wass.

The object of this patent is to utilise a waste product from mineral oils. The acid tar or tarry residue is heated, and a due proportion of resin added. Other acids,—sulphuric or nitric,—are added, and the mixture is thinned down with benzoline turpentine, or such-like solvent. Paint, in black or colours, is made from this compound.

13,920, Sanitary and Drain-pipes and Retorts. J. & B. Craven.

This invention relates to hydraulic presses for moulding pipes in parts, the water-pressure being placed above and around the articles to be moulded.

14,056, Hinges. J. E. Beanland.

This patent consists of a peculiar form of hinge, with a method of fixing which will cause the door to rise on being opened for the purpose of clearing the mat or carpet. When the open door is set at liberty, this hinge will cause the door to close automatically.

15,596, Artificial Pavement. J. W. Macknight.

This invention consists of a pavement of great durability; the upper layer of this pavement, and also the layer next below, are curved downwards at the curb, and thus the ordinary flag or curb stones are dispensed with. The result is a pavement of superior finish and strength, and one which leaves no seams at the curb.

16,234, Wall Ties or Bond Iron. J. Sheldon.

The improvement which is the subject of this patent consists in making with the pieces or lengths of hoop iron, of which the ties are made, a series of corrugations or undulations crossing the said pieces or lengths at right angles to the longer sides. In these corrugations a series of depressions, hemispherical in shape, are made, and these again are perforated to allow condensed moisture, or any liquid falling thereon, to escape.

NEW APPLICATIONS FOR PATENTS.

Sept. 7.—12,924, J. Bradshaw, Chimney-pot or Top.—12,946, T. Line and J. Daveney, Wooden Wainscots, Ceilings, &c. — 12,957, T. Shouler, Springs and Checks for Doors, &c.

Sept. 8.—12,984, G. Robinson, Preventing the Spread of Fire in Buildings.—13,009, R. Holdsworth and H. Garland, Door and other Bolt Locks.

Sept. 10.—13,040, H. McKibbin, Arrangement of Window Frames or Sashes, and Fasteners thereof.—13,059, W. Jarvis, Wall-blocks for Buildings.

Sept. 11.—13,096, J. Rogers, Flushing Cisterns, or Water Waste Preventers.

Sept. 12.—13,155, W. Joynson, Roof Gutters.—13,158, J. Lawson, Heating Buildings by Air and Water.—13,167, W. Jago, Bakers' Ovens.—13,170, J. Kaye, Opening and Closing Fanlights, &c.—13,177, R. Thomson, Combined Lavatory and Water-closet Basins.—13,163, W. Jones, Covering, Lining, and Panelling Walls and Ceilings of Offices, Shops, Passages, &c.—13,201, H. Sharman, Thief-proof Windows and Rising Latch Fasteners.

Sept. 13.—13,243, A. Turnbull, and J. Mathieson, Stoves and Cooking-ranges.—13,244, T. Knowles, Mantelpieces.

PROVISIONAL SPECIFICATIONS ACCEPTED.

14,951, T. Minton and others, Printing upon Pottery and Tiles.—9,184, E. Tobin, Ventilating Dwellings and other Structures.—10,298, J. Way, Chimney-pots.—10,674, T. and J. Holt, Cisterns for flushing Urinals.—10,882, E. and E. Kerry, Joint for Drain-pipes, &c.—10,922, J. de Jong, Tip-waggons.—11,198, E. Brooke, Burning White or Coloured Glazed Bricks and Pottery.—11,238, S. Edmonds and W. Timbrell, Catches or Fasteners for Doors, Gates, &c.—11,260, R. Stevens, Sash Fasteners.—11,279, J. Fejer, Safety Grate or Trellis for Windows.—11,290, E. Poole, Roofing Tiles.—11,433, J. Jackson, Radiators for Warming and Ventilating Buildings.—11,483, H. Planner, Disinfecting Apparatus for Water-closets.—11,737, G. Binswanger, Electric Bell Pushes.—11,798, W. Woodall, Fittings for Electric Bells.—11,908, W. Stock, Flushing Apparatus for Water-closets, &c.

COMPLETE SPECIFICATIONS ACCEPTED.

Open to Opposition for Two Months.

14,776, S. Timings and S. Hill, Spring Catches or Fasteners for Doors, Windows, &c.—14,951, T. Minton and Others, Printing upon Pottery and Tiles. — 15,258, E. Church, Kitchen Ranges.—15,372, J. Morris, Ventilator and Chimney Cowl.—15,405, W. Yates, Ventilating Fans.—15,483, J. Boulter, Automatic Indicator for Water-closets, &c.—15,666, G. Layton, Manufacture of Cement.—17,556, H. Stockman, Ventilators.—17,967, B. Gregory, Blue Bricks, Tiles, Fire-bricks, &c.—5,931, D. Hoey, Ventilating Halls, Rooms, &c.—7,251, R. Partridge, Door Latches.—9,591, E. Thorp, Wind and Water Bars for Meeting Rails,

Top and Bottom Rails of Sliding Sashes, Top Rail and Stiles of Casement Sashes, and the Top Rail and Stiles of Doors.—10,051, J. Witt, Raising or Lowering the Temperature in Buildings, &c.

RECENT SALES OF PROPERTY.

ESTATE EXCHANGE REPORT.

SEPT. 10.

By ALFRED THOMAS, PEYER, & MILES.

Baldock, Herts—Steed's Brewery, with malting, goodwill, and sixty-seven public-houses £22,500

SEPT. 12.

By ELLIS, MORRIS, SUTHERLAND, & Co.

Westminster—33 and 34, New-street, 14 years, ground-rent £9 400

SEPT. 13.

By D. WATNEY & SONS.

Canonbury—8, Alwyne-place, 57 years, ground-rent £10 420

By C. C. & T. MOORE.

Mile End—55, 61, and 63, Bloomfield-road, 79 years, ground-rent £10 845
Shadwell—3 and 4, Albert-street, 74 years, ground-rent £12 650
Commercial-road—3 and 4, Manor-court, copyhold 210
Old Ford—23, Ellesmere-road, freehold 390

By E. STIMSON.

Bermondsey—98, 99, and 100, New Church-road, 10 years, ground-rent £6 185
Peckham—50, Chadwick-road, freehold 310
Stockwell—6 and 8, Hubert's-grove, 86 years, ground-rent £13 400
Camberwell, Picton-street—A plot of freehold land. 52

By WILKINSON & SON (at Brighton).

Brighton—3, Middle-street, freehold 1,020
4 and 5, Silwood-road, freehold 1,310

MEETINGS.

TUESDAY, SEPTEMBER 25.

Society of Engineers.—Visit to the London and South Western Railway Locomotive and Carriage Works at Nine Elms, S.W. Party to assemble at the entrance in Hemans-street, Wandsworth-road, at 1.45 p.m.

Glasgow Architectural Association.—Visit to Barony Established Church. 5.15 p.m.

WEDNESDAY, SEPTEMBER 26.

Builders' Foremen and Clerks of Works' Institution.—Quarterly Meeting of the Directors. 8.30 p.m.

Miscellanea.

Safety of Exits in Theatres. — The *Hamburger Nachrichten* states that a locksmith in that city, by name Woolff, has constructed an apparatus whereby all the doors in a theatre may be opened simultaneously. The other day experiments were made with the apparatus at the Concordia Theatre, and on somebody shouting "Fire," the inventor turned the handle of the apparatus, fixed in the refreshment-bar of the theatre, on which every exit in the whole building opened at once. The arrangement does not preclude the opening of each door in the ordinary manner.

New Buildings at Loughborough. — The Fearon Memorial Hall and Schools at Loughborough are now making progress under the supervision of Mr. Geo. Hodson, C.E., the architect, and Mr. W. Needham, the contractor. We learn that a site has been purchased for the erection of a new church on the Paget estate, where it is proposed to immediately erect a large iron mission room for use during the time the necessary funds are provided for the new church.

Discovery of Roman Remains on the Danube.—The *Wiener Zeitung* states that the remains of a Roman amphitheatre have been discovered at Deutsch-Altenburg, on the Danube. The exceedingly level state of the ground in a corn-field led to the surmise of there being some walls beneath, and on excavations being made, a gallery and remains of a Roman amphitheatre were discovered. Close by, the remains of a Roman road were also discovered.

Belfast Main Drainage Scheme.—On the 12th inst., Mr. McCammond, Chairman of the Belfast Town Improvement Committee, performed the ceremony of cutting the first sod in connexion with the Belfast Main Drainage Scheme. Mr. J. C. Bretland, Borough Surveyor of Belfast, has been appointed engineer to the works, which, it is estimated, will cost about £300,000.

Wallingford.—A Church House and Sunday School, in connexion with St. Leonard's Parish, has been recently opened in Wallingford by Lady Wantage. The architect was Mr. S. C. Johns, of Crowmarsh, Oxon, and the contractors, Messrs. Brasher Bros., a local firm.

Roman Catholic Cathedral in Pekin.—The *Popolo Romano* states that active progress is being made with the new Roman Catholic Cathedral now in course of erection in Pekin, 600 workmen being at present engaged on the work.

The Explorations at Roche Abbey.—During the past twelve months the work of exploration has been steadily progressing at Roche Abbey, upon the estate of Earl Scarborough. Roche Abbey was founded about 1147 for Cistercian monks. Of late, the work of excavation has been conducted by the Rev. F. H. Valpy, chaplain to Earl Scarborough. Some time ago his Lordship exhibited before the Society of Antiquaries a remarkable block of stone, a cube of 9 in. with a cavity in the top, covered by a smaller stone, which had been discovered in the ruins. When opened it was found to contain a relic, consisting of a splinter of bone, and a broken iron ring, wrapped up in sheet lead. Mr. W. St. John Hope and Mr. J. T. Micklethwaite, who inspected it, suggested that the relics were those of St. Godric, whose mail-shirt was a source of numerous like treasures over the North of England, and that the stone has been built upon one of the altars. The screen of the edifice has been unearthed, and is 78 feet from the main (western) entrance, and 81 ft. 9 in. from the chancel steps. There are three doorways at the western side, and these are laid open to view. The position of the choir-stalls has been fixed, while in the body of the church, just outside the screen, are several tombs bearing inscriptions and designs. The one immediately in front of the door leading to the choir-stalls is a slab with an English inscription, and supposed to be the middle or the end of the fifteenth century; nearly all the words have been deciphered, but a few are too much broken for identification. It reads—"Here lyggs Peryn of Doncastre, and Isabel his wyfe, a gude tru-brother while he was on lyfe. Jesu by Thy mercy bring them to blysse, Pater noster for them, whoso redis thys." Another contains a Latin inscription to the following effect:—"Here lies — Rilston, gentleman, a benefactor of this monastery, who died the 9th day of August, in the year of our Lord 1498, to whose soul may God be favourable, amen." An adjoining tombstone bears the name Rilstone, and is evidently belonging to the same family. There are three others which appear to be of an older date, two of them bearing no inscription at all. The kitchen has been explored, and the walls of the refectory have been traced, and will be soon worked out. *Leeds Mercury.*

National Registration of Plumbers.—A presentation of certificates took place in the Town-hall, Dundee, on Saturday afternoon. Mr. John J. Henderson, A.M.I.C.E., presided, accompanied by Mr. W. Farquharson, Secretary to the District Council. The Chairman, after referring to the spread of the movement, said that probably no artisan holds the keys of disease in his grasp so completely as the plumber, who by good workmanship may exclude forces inimical to health, or by his incompetency may give entrance to malign influences that inflict suffering, and even death, upon their victims. He hoped the classes about to be started through the District Council would gradually tend to establish a high order of proficiency in the craft. Eight certificates were then presented, which, along with those presented last week in Fife and Perth, make eighteen for this month.—*Dundee Advertiser.*

The Electric Light in Berlin.—Experiments are now being made in Berlin with the electric light for street lighting, the first thoroughfare in which it has been introduced being the well-known avenue Unter den Linden. This is lighted by 108 arc lamps, extending from the Pariser Platz to the Royal Palace. The lamps are suspended from chains running between cast-iron poles 24 ft. in height. The latter are round, and ornamented with heads of lions and the Imperial arms at the base, and an eagle at the top. In the central avenue the distance between the lamps is about 100 ft., but in other parts, except at the crossing of the Friedrick's Strasse, more. The motive power is supplied by four dynamos stationed in the adjacent Mauer Strasse, and the strength of each lamp 2,000 candle-power. Up to the present the experiment has been a great success.

Milford-on-Sea.—A large new hotel, to be called the "Hotel Victoria" (why not the "Victoria Hotel," seeing it is in England, and not in France?), is to be erected here. The builders, Messrs. Rashley Bros., of Lymington, have entered into a contract with the owner of the estate to erect and complete the hotel within eighteen months. The architect is Mr. Evans, of Lymington and Westminster, the surveyor to the estate. We hope the hotel is not going to be "rushed up" too quickly for good building and proper finish.

New Roman Catholic College at Tooting.—The large and costly new Roman Catholic college, which has for some time past been in course of erection at Tooting, and is now completed, was opened on Monday for the reception of students. The building has been erected on the Hill House Estate, immediately adjoining Tooting Bec-common. The mansion and estate, which cover an area of nearly twenty acres, were purchased for the purposes of the college for about £15,000. The highest point on the estate has been selected for the college buildings, which cover a ground area of 20,000 square feet, and rise in four stories to a height of 74 ft. From the roof springs a turret, which serves the twofold purpose of a clock-tower and observatory. The buildings are in red brick and Portland stone dressings, the style of architecture being French Renaissance. The basement floor contains the kitchen, refectories, college-hall, play-rooms, and bath-rooms. On the ground floor are the reception-rooms, class-rooms, study-halls, physical and chemical lecture-rooms, and laboratories. The laboratory fittings have all been made by Mr. Heywood, of Manchester, who fitted up all the appliances at Owens College. The chapel is on the first floor. The altar is in Caen stone, the altar table being of white-veined marble, supported by four pillars of Irish marble. The organ has been built by Mr. Ingram, of Holloway. The building is heated by hot-water pipes. These pipes have been planned and fitted by Messrs. Barry & Sons, of Westminster. The sanitary arrangements have all been carried out by Messrs. Finch & Co., of Lambeth. The dormitory arrangements in the upper floors have been carried out by Messrs. Shoolbred & Co., of Tottenham-court-road. The college has accommodation for 200 resident students, and as many day students. Mr. W. Harvey, of Whitehall-place, is the architect, and Messrs. Higgs & Hall are the contractors, their contract being about £40,000. The grounds have been ornamentally laid out for recreation purposes, six acres having been set apart for cricket-playing. The mansion, which was included in the purchase, will be used as the sanatorium of the college.

New Theatre, Coventry.—A new theatre, which is expected to be ready for opening early in the coming year, has been commenced at Coventry. The building, which is situated in Hales-street, will be of red brick with stone dressings, and will be decorated with carved brick and stone work. The auditorium will contain pit and stalls on the street level; dress circle tier, with boxes, and gallery tier; and each part of the house will have two distinct exits or staircases. Access will be gained from Hales-street through four pairs of folding doors, to the central vestibule, from which a double staircase will lead to the dress circle and boxes; and between the staircases will be a passage leading directly into the pit. On each side of the box entrance will be double entrances to the pit and gallery. The pit will be 48 ft. wide and 54 ft. long. On the opposite side of the pit will be another exit from that part of the house and the stalls. Passing up the double staircase in the central vestible a wide foyer will be reached, from which an entrance will be gained to the dress circle tier. The gallery, which will contain eight rows of seats, will be approached by two wide staircases, access being gained to them through the triple sets of folding doors which serve for double entrances to pit and gallery. The stage will be nearly 70 ft. wide, while its depth will be 30 ft.; and it will be of fire-proof construction. In front of the proscenium there will be a wide and commodious orchestra, and staircases will rise from the orchestra stalls on each side to the dress circle. The internal decorations will be in a free Renaissance style, lincrusta designs and gilding being largely introduced. The tiers will be supported by light pillars. The architects are Messrs. Essex & Nicol, of Birmingham, and Mr. C. G. Hill, of Coventry, is the contractor.

Proposed Sewage Scheme for Fulwood.—Mr. Taylor, an Inspector of the Local Government Board, has held an inquiry into the sewerage scheme for which the Fulwood Local Board have applied for sanction to borrow £1,000. The Fulwood Board propose to adopt Mr. Conder's system of purification. The scheme was opposed at the inquiry on the ground that a very extensive sewerage scheme for Preston was in preparation, that Fulwood would soon be practically a part of Preston, and that it was undesirable to multiply sewerage schemes.

Sale of Building Land near Herne Bay.—About a mile to the west of Herne Bay, a new sea-side locality, designated Hampton-on-Sea, is at present being laid out for building upon. The property includes what is called the Grand Parade Estate, on which several roads facing the sea are now in course of formation. On Monday last, the first portion of the property was offered for sale in a marquee on the estate, by Messrs. Baker & Sons. The plots offered were 146 in number, and included a hotel and several shop plots, in addition to sites for private houses, described as well adapted for the erection of bungalows, rustic cottages, and medium-sized villas. There was a numerous company present at the sale, a special train from Holborn Viaduct station to Herne Bay taking down upwards of 300 buyers and others. The plots submitted contained frontages varying from 19 ft. to 24 ft., and depths of from 70 ft. to 90 ft. On the sale commencing, there was a close and severe competition for the several lots, all of which were sold within an hour, several purchasers taking as many as six, ten, and twelve lots each. The prices realised ranged from 10*l.* to 12*l.* each for the sites in the roads running southwards from the sea, whilst those in Hampton-parade, facing the sea, were sold for 20*l.* each. The hotel plot realised 42*l.* The proceeds of the sale amounted to about 2,000*l.* Several acres on the estate have been reserved for the formation of public gardens, and the erection of a free library and reading-room.

Proposed Registration of Plumbers.—A largely-attended meeting to consider the question of the registration of plumbers was held on Monday evening, at the Town-hall, Stockton-on-Tees, under the presidency of the Mayor. In opening the proceedings, the Mayor remarked that the object of the registration scheme was not to promote any trade interest, but to promote the public health. The purpose of the meeting was to appoint local representatives to the district council, formed to deal with the registration of plumbers in the four northern counties and the North Riding of Yorkshire. The council consists of an equal number of representatives of the master and operative plumbers and of the public. Dr. J. H. Clegg (medical officer), who was one of the public representatives elected, cited cases from his own personal experience where sewer gas had been most carefully laid on in houses in which fever had broken out. A second meeting was held at the Free Library, Liverpool, under the presidency of Mr. J. B. Smith, chairman of the Liverpool Health Committee. Representatives for the district registration committee were elected—among others Dr. Stopford Taylor, Dr. Vacher, and Dr. Sprakeling (medical officers of health for Liverpool, Birkenhead, and Bootle, respectively), and Mr. Kirby, president of the Liverpool Architectural Institution, to represent the public.

The English Iron Trade.—The English iron market maintains a steadily upward tendency, and an activity which has seldom been surpassed. At the same time, the trade done is of a thoroughly sound character, and the demand genuine, very little speculative business being attempted. Although the Glasgow warrant market has fluctuated greatly during the week, this has not interfered with the trade done by Scotch makers, who have advanced their quotations, the enhancement ranging from 6d. to 2s. 6d. a ton, according to brand. Cleveland ironmasters are also holding out for more money, and the price of No. 3 Middlesbrough is firm at 35s. 3d., prompt, or 3d. a ton more. In Lancashire, pig-iron is 1s. a ton dearer. Bessemer iron, in the North-west, has been put up from 3d. to 6d. per ton. The manufactured iron market is very active. Advances of 2s. 6d. for boiler plates, 5s. for ship-plates, and 2s. 6d. for bars and angles are announced. The demand is very heavy, as is also that for steel. Steel ship-plates are very firm at 7*l.* and 7*l.* 2s. 6d., and angles have gone up to 6*l.* 10s. and 6*l.* 12s. 6d., but for prompt delivery, ship-builders have to pay 2s. 6d. and even 5s. per ton more. The prospects of the ship-building trade have never been brighter. There is a continued steady improvement in engineering.—*Iron.*

Swedish Paviors in St. Petersburg.—In order to teach Russian workmen the methods of paving with granite, and to superintend the extensive works of paving to be undertaken in St. Petersburg, and to which we recently referred, twenty-five master-paviors have been introduced from Stockholm into the Russian capital.

PRICES CURRENT OF MATERIALS.

TIMBER.	£.	s.	d.	£.	s.	d.
Teak, E.I.....load	8	0	0	12	10	0
Sequoia, U.S.....foot cube	0	0	3	0	3	0
Birch, Canada .....load	2	15	0	4	15	0
Fir, Dantsic, &c.	2	0	0	4	0	0
Oak ,, ...	2	0	0	4	10	0
Canada	4	0	0	6	10	0
Pine, Canada red	2	10	0	3	10	0
,, yellow	2	10	0	4	0	0
Lath, Dantsic.....fathom	3	10	0	5	0	0
St. Petersburg.....	5	0	0	6	0	0
Wainscot, Odessa, crown.....	2	10	0	3	0	0
Deals, Finland, 2nd and 1st...std.100	8	0	0	9	10	0
,, 4th and 3rd.....	6	10	0	7	10	0
Riga	6	0	0	7	10	0
St. Petersburg, 1st yellow	9	10	0	15	0	0
,, 2nd ,, ...	8	0	0	9	0	0
,, white	7	10	0	10	0	0
Swedish.....	7	10	0	16	10	0
White Sea	8	10	0	17	10	0
Canada, Pine, 1st	15	0	0	24	0	0
,, ,, 2nd	9	10	0	15	10	0
,, ,, 3rd, &c.	7	10	0	9	10	0
,, Spruce, 1st	8	10	0	9	10	0
,, 3rd and 2nd	6	0	0	7	10	0
New Brunswick, &c.	6	10	0	7	5	0
Battens, all kinds	4	10	0	11	0	0
Flooring Boards, sq., 1 in., prepared, First	0	10	6	0	13	6
Second	0	7	0	0	10	3
Other qualities	0	4	6	0	6	9
Cedar, Cuba.....foot	0	0	3½	0	0	3¾
Honduras, &c.....	0	0	3½	0	0	3¾
Australian	0	0	2	0	0	3
Mahogany, Cuba	0	0	4½	0	0	5½
St. Domingo, cargo average	0	0	4½	0	0	5½
Mexican ,, ...	0	0	4	0	0	4½
Tobasco ,, ...	0	0	4½	0	0	5½
Honduras ,, ...	0	0	4½	0	0	5½

TIMBER (*continued*).	£.	s.	d.	£.	s.	d.
Box, Turkey .....ton	5	0	0	12	0	0
Walnut, Italian .....foot	0	0	4½	0	0	6
METALS.						
IRON—Bar, Welsh, in London...ton	4	17	6	5	0	0
,, ,, at works in Wales ...	4	7	6	4	10	0
,, Staffordshire, in London ...	5	5	0	6	15	0
COPPER—						
British, cake and ingot..... ton	77	10	0	78	10	0
Best selected	79	0	0	80	0	0
Sheets, strong	85	0	0	0	0	0
Chili, bars	95	0	0	97	0	0
LEAD—						
Pig, Spanish .....ton	13	10	0	0	0	0
English, common brands	13	15	0	13	17	6
Sheet, English.....	14	15	0	0	0	0
SPELTER—						
Silesian, special .....ton	18	15	0	19	0	0
Ordinary brands.....	18	12	6	18	17	6
TIN—						
Straits .....ton	104	0	0	0	0	0
Australian	104	0	0	0	0	0
English Ingots.....	107	10	0	0	0	0
ZINC— English sheet.....ton	21	0	0	0	0	0
OILS.						
Linseed .....ton	19	10	0	19	12	6
Cocoanut, Cochin	26	0	0	28	0	0
Ceylon	25	0	0	0	0	0
Palm, Lagos	23	0	0	0	0	0
Rapeseed, English pale	28	10	0	0	0	0
,, brown	27	0	0	27	5	0
Cottonseed, refined	21	15	0	22	0	0
Tallow and Oleine	25	0	0	45	0	0
Lubricating, U.S.	4	0	0	6	0	0
,, refined	7	0	0	12	0	0
TURPENTINE—						
American, in casks.....cwt.	1	8	9	0	0	0
TAR—						
Stockholm .....barrel	0	16	0	0	16	6
Archangel	0	10	0	0	10	6

CONTRACTS AND PUBLIC APPOINTMENT.

Epitome of Advertisements in this Number.

CONTRACTS.

Nature of Work, or Materials.	By whom required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.	Page.
Re-construction of Sanitary Fittings, &c.	Romford Union	C. J. Dawson.....	Sept. 24th	ii.
Laying Cast-iron Pipes	Nelson Local Board.....	J. Newton & Son.....	Sept. 27th	ii.
Sluice Valves, Hydrants, &c.	do.	do.	do.	ii.
School Extensions and Alterations	Burton-on-Trent (U.D.) School Board	R. Churchill	do.	ii.
Broken Granite and Flint	Twickenham Loc. Board	H. M. Ramsay	do.	xii.
School Room, Llanelly	The Committee.....	.....	Sept. 28th	ii.
Two Shelters	Lytham Imp. Com....	*Official*.....	do.	xii.
Thames Ballast, Sand, and Cement.....	Paddington Vestry	do.	Oct. 1st	xi.
Yellow Deal Blocks for Paving.....	do.	do.	do.	xi.
Rain-water Tank	St. Marylebone Grdns.	J. Anstie	do.	xi.
Repairs, Cleansing, &c., School	St. Matthew (Bethnal Green) Guardians.....	A. & C. Harston	Oct. 2nd	xi.
Dwarf Wall and Iron Fence	Brentford Local Board	— Lacey.....	do.	xii.
Broken Granite	Aldershot Local Board	W. L. Coulson	do.	xii.
New Passenger Station, North Shields	North Eastern Ry. Co....	W. Bell	Oct. 3rd	ii.
Stone for Macadamising	Hull Corporation	A. E. White	Oct. 4th	xii.
Sea-Wall and Esplanade	Sandown Local Board...	J. Newman	do.	xii.
Pipe-Sewers, &c.	Wanstead Local Board	*Official*.....	do.	ii.
Houses with Outbuildings, Seaton Sluice	Admiralty	do.	Oct. 5th	ii.
Rolled Iron Joists	Hornsey Local Board ...	T. De Courcy Meade ...	Oct. 8th	xi.
Road-Making Works.....	do.	do.	do.	xi.
Drainage Works.....	Ecclesall Bierlow R.S.A	T. G. Edwards	Oct. 10th	xii.
Works and Repairs to Buildings	Com. of H.M. Works...	*Official*.....	Oct. 12th	ii.
Hospital, Hereford.....	.....	E. H. Lingen Barker ...	Not stated	xii.

PUBLIC APPOINTMENT.

Nature of Appointment.	By whom Advertised.	Salary.	Applications to be in.	Page.
Surveyor and Inspector of Nuisances.....	Dartford Local Board...	200*l.*	Sept. 27th	xvi.

TENDERS.

[Communications for insertion under this heading must reach us *not later than* 12 *Noon on Thursdays.*]

BATTERSEA.—For new bakery, stables, &c., in Harroway-road, Battersea, for the Battersea and Wandsworth Co-operative Society, Limited :—

Neil	£2,217	0	0
Beale	1,888	0	0
Richardson & Co.	1,811	0	0
Brickell	1,784	0	0
Hammond (accepted)	1,765	0	0

CHELMSFORD.—For the erection of a vestry-hall in New-street, for the Parish Officers. Mr. F. Whitmore, architect, Chelmsford :—

H. Potter	£476	0	0
A. Roper.....	455	0	0
G. Beaumont.....	432	0	0
Mrs. Moss	429	0	0
W. Fincham	419	0	0
Frank Johnson	377	0	0
C. J. Baker (from revised plans)*	456	0	0

* Accepted.

FULHAM.—For stables, superintendent's house, &c., in Munster-road, for the Fulham Vestry. Mr. J. P. Norrington, architect. Quantities by Mr. F. H. A. Hardcastle :—

Temple & Graham.....	£7,200	0	0
Longley	6,965	0	0
Henley & Co.....	6,924	0	0
Woodhouse	6,576	0	0
Foster & Dicksee	6,333	0	0
Boller	6,320	0	0
Higgs	6,250	0	0
J. O. Richardson	5,919	0	0
Ashford	5,580	0	0
Nye	5,417	0	0
Brickell	5,249	0	0
A. R. Flew & Co. (accepted).....	5,158	0	0

FULHAM.—For building river-wall and embankment, at Swan Wharf, Fulham Bridge, for Mr. J. W. Bowden. Mr. Alfred C. Bean, engineer, Shepherd's-bush :—

Nowell & Robson	£2,040	0	0
Joseph Mears.....	1,946	0	0
Cooke & Co.	1,500	0	0
Williams, Son, & Wallington*.....	1,500	0	0

* Accepted.

HAMMERSMITH.—For making up, paving, &c., of six roads in the parish of Hammersmith, for the Vestry, Mr. H. Mair, surveyor.

Abdale, Cross, and Weltje Roads.

Kellett.....	£2,472	0	0
Bell	1,998	0	0
Trehearne.....	1,924	0	0
Nowell & Robson	1,884	0	0
Tomes & Wimpey	1,864	0	0
Adams.....	1,832	0	0
Coat.....	1,763	0	0
Rogers & Co. (accepted).....	1,680	0	0

Clifton-road and Coleman's-buildings.

Kellett.....	£829	0	0
Bell	744	0	0
Coat.....	717	0	0
Tomes & Wimpey.....	679	0	0
Treahearne.....	669	0	0
Nowell & Robson	669	0	0
Rogers & Co.	663	0	0
Adams (accepted)	624	0	0

Argyle-passage.

Kellett.....	£175	0	0
Bell	143	0	0
Coat.....	125	0	0
Adams.....	123	0	0
Nowell & Robson	123	0	0
Rogers & Co.....	113	0	0
Trehearne (accepted)	105	0	0

HAVERHILL (Suffolk).—For the erection of New Corn Exchange, for the Board of Directors. Mr. F. Whitmore, architect, Chelmsford :—

Everett & Son, Colchester	£1,473	0	0
C. E. Orfeur, Colchester	1,398	0	0
Grimwood & Son, Sudbury	1,395	0	0
Mason & Son, Haverhill	1,329	0	0
F. Dupont, Colchester	1,275	0	0
A. Diss, Colchester (accepted)	1,250	0	0

HESWALL (Cheshire).—For the erection of house, for the Rev. J. Fox. Mr. J. W. Auger, architect, Liverpool :—

J. & F. Kitchen	£640	0	0

[No competition.]

HORNSEY.—For repairs, &c., at No. 44, Tollington Park, Hornsey. Mr. G. Gordon Stanham, architect, 100B, Queen Victoria-street, E.C. :—

Hemson	£388	16	6
Hideman	352	10	0
Dearing & Son	345	14	0
Spencer & Co.	345	0	0

HURST (Lancashire) :—For the erection of a dwelling-house, Turner-lane, Hurst, for Mr. S. Sidebottom. Mr. J. H. Burton, architect, Ashton-under-Lyne.

Walter Clough, Ashton-under-Lyne	£445	0	0
J. Whatmough, Hurst	444	10	0
J. W. Williamson, Ashton-under-Lyne	438	0	0
Jabez Gibson, Dukinfield	416	0	0
William Tickle, Dukinfield	414	10	0
Fitton & Bowness, Ashton-under-Lyne	414	0	0
James Garside, Ashton-under-Lyne	411	0	0
Charles Morris, Ashton-under-Lyne	399	0	0
Thomas Dean, Ashton-under-Lyne	385	0	0
Allen Holmes, Ashton-under-Lyne	385	0	0
John Robinson, Ashton-under-Lyne*	385	0	0

* Accepted.

LONDON.—For shop-fittings, &c., at 239, Upper-street, Islington, for Mr. Hawkey. Mr. J. Farrar, architect, Albion Chambers, Moorgate, E.C. :—

Harris	£169	0	0
Lobb & Ollver	155	0	0
Dearing & Son	148	0	0
Bamford	147	10	0
W. Smith	129	10	0
Wolveridge Bros.	118	0	0

LONDON.—For repairs and alterations to St. Peter's Vicarage, Cross-street, Hatton Garden, for the Rev. E. Canney. Mr. J. D. Matthews, architect, 11, Dowgate-hill, E.C. :—

N. Fearman	£247	19	0
R. D. Lown & Son	234	10	0
Wontner, Smith, & Son	229	0	0
Durrant	179	0	0

LONDON.—For supplying wainscot-panelling and doors in dining-room at 52, Sloane-street, for Mr. Wilson Noble, M.P. Mr. J. A. Stenhouse, architect :—

C. Hindley & Sons (accepted)	£185	0	0

LONDON.—For paving works at Messrs. Tingle & Jacobs's new premises, Hanbury-street. Mr. R. W. Hobden, architect :—

W. H. Wheeler (accepted)	£415	0	0

LONDON.—For drain and paving works at Messrs. Spiers & Pond's stables, Charlotte-street, S.E. Mr. Sidney Hargraves, surveyor :—

W. H. Wheeler (accepted)	£148	0	0

LONDON.—For rebuilding No. 9, Gough-square, for Messrs. Pardon & Sons. Mr. J. Douglass Mathews, architect, 11, Dowgate-hill, E.C. :—

Brass & Son, Old-street	£2,197	0	0
W. Shepherd, Bermondsey	2,185	0	0
Dove Bros., Islington	2,145	0	0
Downs, Walworth	2,140	0	0
Nightingale, Lambeth	1,987	0	0
Killby & Gayford, Worship-street*	1,953	0	0

* Accepted, subject to modification.

LONDON.—For alterations and additions at the "Three Wheatsheaves," Islington, for Mr. R. Rhodes. Mr. J. H. Laurance, architect and surveyor.

E. Spanton (accepted)	£952	0	0

OSWESTRY.—For supplying parquet floor for the Victoria Assembly-rooms, Oswestry :—

C. Hindley & Sons, London (accepted)	£152	0	0

PITSEA (Essex).—For the erection of the "Bull Inn," for Messrs. Crabb, Veley, & Co. Mr. F. Whitmore, architect, Chelmsford :—

A. Diss, Colchester (accepted)	£620	0	0

NEWMARKET.—For building the infectious hospital, cottage, &c., for the Rural Sanitary Authority of Newmarket :—

Henry Turner, Emmanuel-road, Cambridge	£2,506	0	0
Hugh Cave, Thorney, Peterborough	2,045	12	0
Redding & Son, Cambridge	1,950	0	0
Blyth & Hunt, Newmarket	1,917	2	6
Kent & Holland, Newmarket	1,916	0	0
Richard Arber, Newmarket	1,864	0	0
Plummer, Rattlesden, and Hook, Soham	1,788	0	0
Harry S. Linsell, Newmarket	1,694	0	0
H. C. Coulson, Cambridge	1,665	0	0
P. Banyard, Cambridge	1,602	10	0
Cowell & Son, Soham	1,552	0	0
Charles Kidman, Cambridge*	1,428	0	6

* Accepted.

READING.—For the erection of two detached houses in Berkeley-avenue, Reading, for Mr. J. B. Monck. Messrs. Cooper & Son, architects, Blagrave-street, Reading. Quantities by the architects :—

Ruffell Bros.	£960	0	0
Winter & Fitt	887	0	0
John Bottrill	885	0	0
Thos. Pilgrim	880	0	0
Geo. Lewis	845	0	0
Collier & Catley	809	0	0
W. Goodchild	759	0	0
W. Poffley	710	0	0

[All of Reading.]

READING.—For laying main sewer and constructing manholes in Berkeley-avenue, Coley, for Mr. J. Bligh Monck. Messrs. Cooper & Son, architects and surveyors, Reading :—

Collier & Catley, Reading (accepted)	£255	0	0

SOUTH SHIELDS. — For the Westoe-road Board Schools. Mr. J. H. Morton, architect, South Shields :—

R. Goodwin & Son, South Shields	£16,984	0	0
Middlemiss Bros., Newcastle	16,472	0	0
James Young, Tynedock	15,585	0	0
Wm. Scott, South Shields	15,581	0	0
John Vinton, South Shields	15,485	0	0
James Douglass, Cullercoats	15,312	0	0
R. Summerbell, Tynedock	15,267	0	0
D. & J. Ranken, Sunderland	15,235	0	0
Thos. Fortune, North Sunderland	15,212	0	0
Peter Marshall, South Shields	15,136	0	0
J. B. Weir, South Shields	14,949	0	0
J. & W. Lowry, Newcastle	14,709	0	0
D. Lawes & Company, South Shields	14,595	0	0
Thos. Lumsden, Jarrow	14,459	0	0
Kilburn Bros., South Shields	14,247	0	0
W. Scott & Son, Sunderland	13,980	0	0
E. Anderson, South Shields	13,846	0	0
Jos. Elliott, North Shields	13,840	0	0
Robt. Allison, Whitburn *	12,994	0	0
Thos. Pigg, South Shields	11,710	0	0

* Accepted.

WEST HAMPSTEAD. — For erecting five houses at West Hampstead. Mr. Edward Clarke, architect, 13, Aldersgate-chambers, E.C. Quantities supplied :—

F. W. Jones, Peckham	£1,805	0	0
H. Pickersgill & Smith, Loughboro' Junction	1,793	0	0
R. M. Priestley & Co., Camberwell*	1,775	0	0

* Accepted.

WOKING.—For alterations and additions to "Firlands," Woking, for Mr. E. Prier. Mr. E. P. Loftus Brock, architect :—

John Till	£1,256	13	0
Mattock Bros.	1,240	0	0
Jas. Whitburn	1,180	10	0
Geo. Shears	1,120	0	0
H. Ingram	1,080	0	0
Howe & White	1,080	0	0
P. Peters	1,025	0	0
A. J. Batchelor	970	0	0

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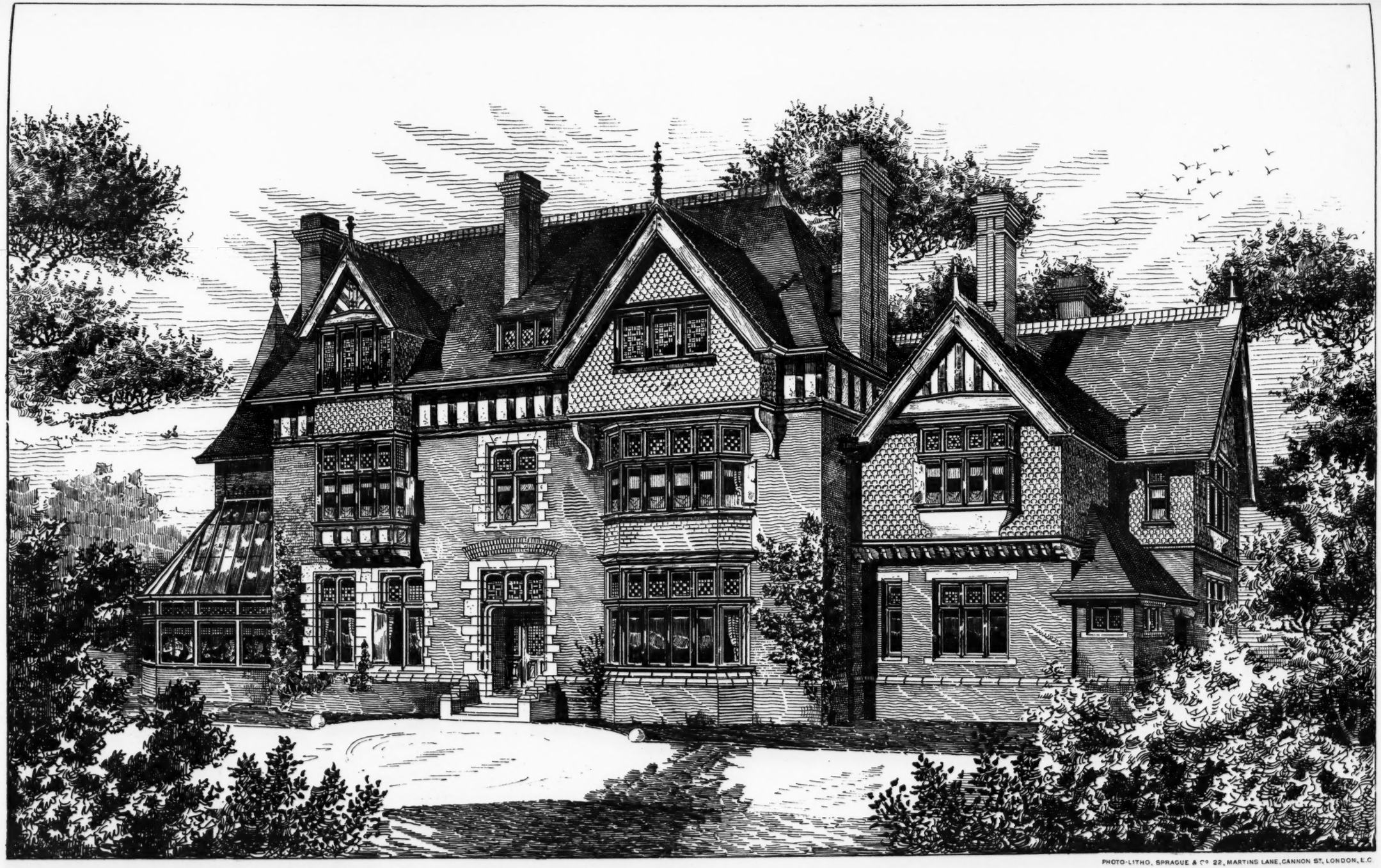

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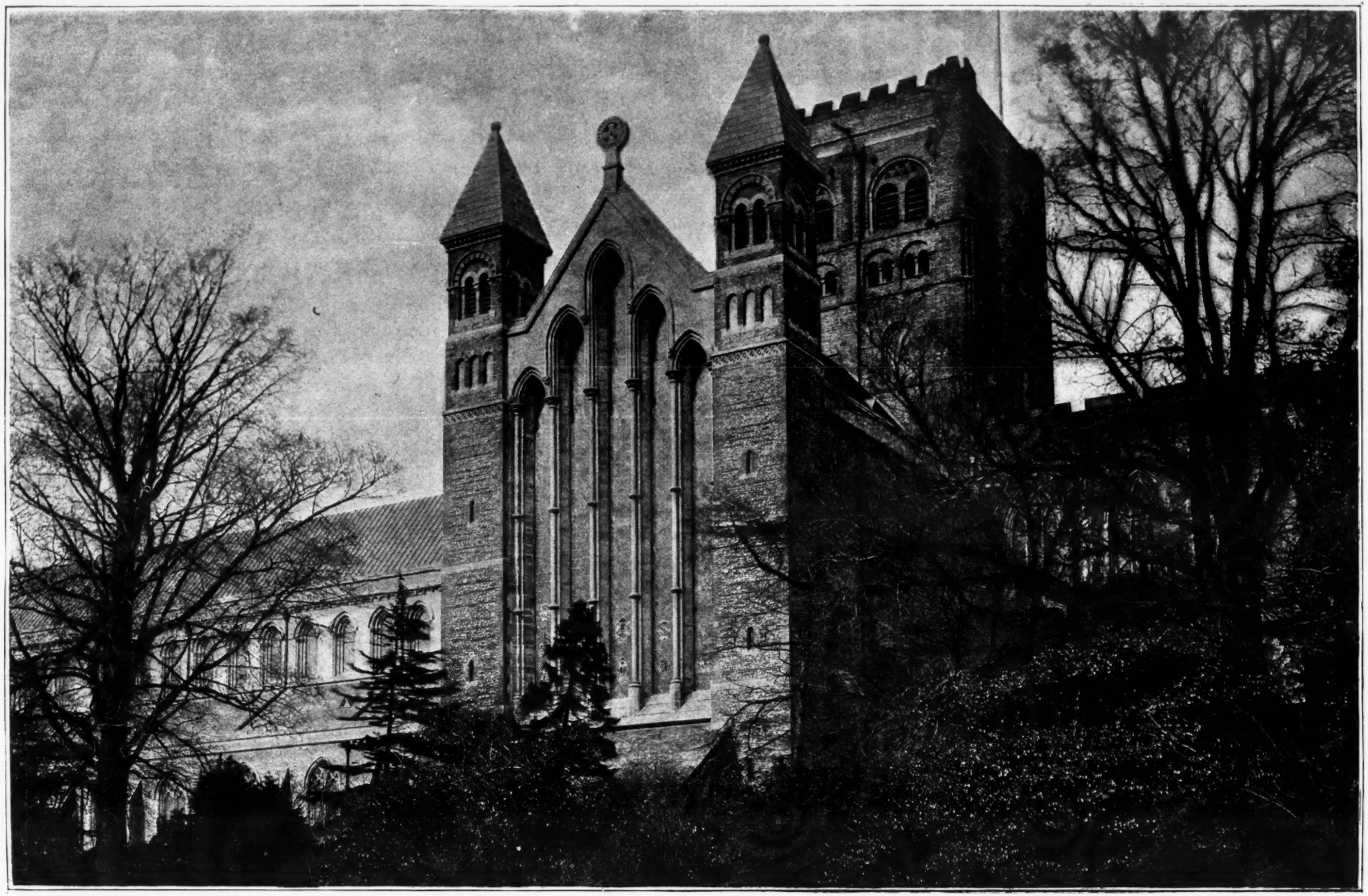

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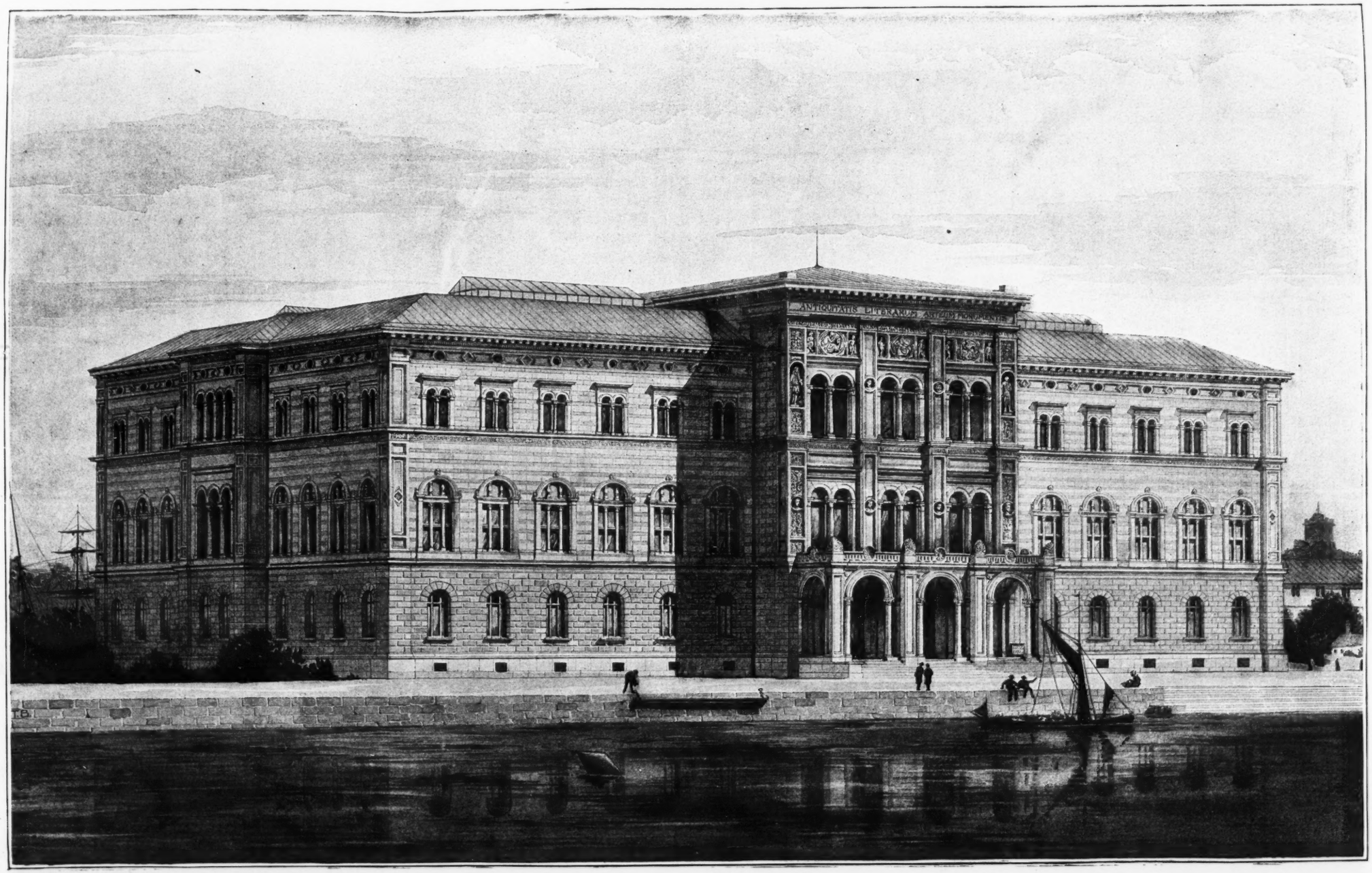

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